UNIVERSIDADE DA CORUÑA

Escola Politécnica Superior

Trabajo Fin de Grado
CURSO 2020/2021

PETROLERO (TANQUE CRUDOS) 250000 TPM

GENO-2020-02

Grado en Ingeniería Naval y Oceánica

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1 TÍTULO Y RESUMEN

1.1 Castellano

El buque que se proyectará en este trabajo es uno para el transporte de un gran volumen de crudo, un petrolero de crudo VLCC, cuya característica principal es su capacidad de carga máxima de 275000 toneladas de peso muerto, según la RPA. En estos cuadernos se recoge el proceso completo de diseño, construcción y evaluación económica desarrollado para la obtención de dicho buque.

1.2 Galego

O buque que se proxecta neste traballo é un para o transporte dun gran volume de crudo, un petroleiro de crudo VLCC, cuxa característica principal é a súa capacidade de carga máxima, dada pola RPA, 275000 toneladas de peso morto. Nestes cadernos recóllese o proceso completo de diseño, construción e evaluación económica desenrolado para a obtención de dito buque.

1.3 English

The ship that will be projected in this work is one for the transport of a large volume of crude, a very large crude oil tanker (VLCC), whose main characteristic is its maximum load capacity of 275,000 deadweight tons, according to the PAR. These notebooks collect the complete process of design, construction and economic evaluation developed to obtain the mentioned ship.

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TRABAJO FIN DE GRADO

CURSO 2020/2021

PETROLERO (TANQUE CRUDOS) 250000 TPM

Grado en Ingeniería Naval y Oceánica

Cuaderno 1:

DIMENSIONAMIENTO. ELECCIÓN DE LA CIFRA DE MÉRITO, DEFINICIÓN DE ALTERNATIVAS Y SELECCIÓN DE LA MÁS FAVORABLE.

Escola Politécnica Superior

UNIVERSIDADE DA CORUÑA

SIMULTANEIDAD DE GRADO EN INGENIERÍA NAVAL Y OCEÁNICA E INGENIERÍA MECÁNICA

TRABAJO FIN DE GRADO

CURSO 2020-2021

PROYECTO NÚMERO

TIPO DE BUQUE: Petrolero (tanque de crudos)

CLASIFICACIÓN, COTA Y REGLAMENTOS DE APLICACIÓN: DNV, SOLAS, MARPOL

CARACTERÍSTICAS DE LA CARGA: 275000 toneladas de peso muerto

VELOCIDAD Y AUTONOMÍA: 15.5 nudos en condiciones de servicio. 20000 millas a velocidad de servicio.

SISTEMAS Y EQUIPOS DE CARGA / DESCARGA: Bombas para carga y descarga de tanques.

PROPULSIÓN: Motor diésel acoplado a una hélice de paso fijo.

TRIPULACIÓN Y PASAJE: 36 personas distribuidas en camarotes individuales y dobles.

OTROS EQUIPOS E INSTALACIONES: Los habituales en este tipo de buques.

Ferrol, 04 de Octubre de 2020

ALUMNO/A: **Dª Minerva Rivas Cabanas**

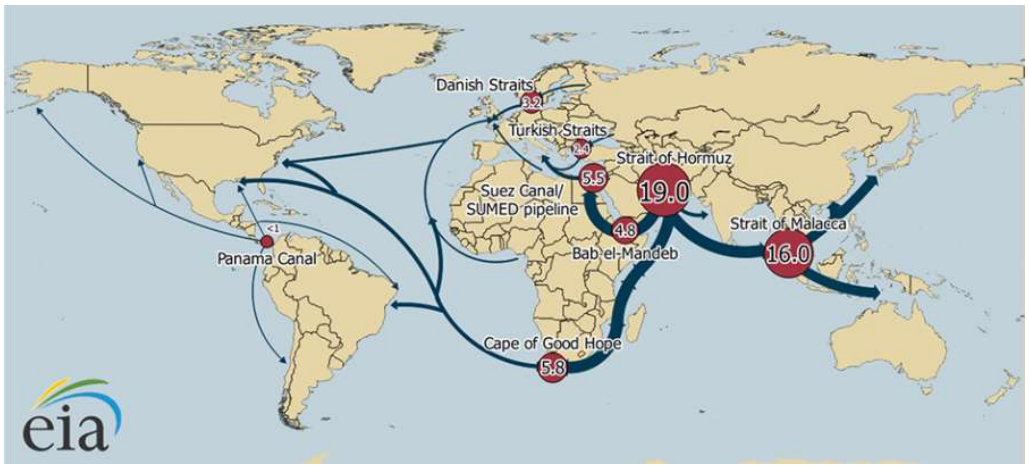
CONTENIDO

2 CONTEXTO HISTÓRICO

En la actualidad, debido a la sociedad de consumo y a la globalización de la economía, el transporte marítimo es destinado como el recurso más apropiado para la transferencia de bienes materiales y no materiales como tecnología y mercancía, además, está afianzado como método con el fin de acercar mercado, fabricante y productor. Las mejoras en el sector del transporte marítimo lo han convertido en el medio más rentable, seguro y eficaz para las tareas anteriormente mencionadas.

Como dato a destacar y según la Conferencia de las Naciones Unidas sobre Comercio y Transporte (UNCTAD), más del 90% del comercio mundial se transporta por mar. Dentro de ese porcentaje, el número de buques dedicados al transporte de petróleo crudo y sus derivados es de 7200 unidades (13.6%), suponiendo 197.9 millones de GT (un 25% del total).

El petróleo es la materia prima más transportada del mundo y su producción mundial se acerca actualmente a 4000 millones de toneladas anuales. La producción de este está concentrada en ciertas zonas del mundo, desde donde se debe transportar a los países demandantes. Las grandes rutas del petróleo proceden de: Oriente Medio (de aquí procede la cuarta parte de la producción mundial), África Occidental, Norte de África y Caribe hacia Europa (importa el 1/8 de la producción mundial), Japón y América del Norte.



2.1 Descripción general de un petrolero

Un petrolero es un buque destinado al transporte de crudo o a productos derivados del petróleo. Hoy por hoy, la mayor parte de los petroleros en construcción, debido al obligado cumplimento de la legislación vigente del Convenio Marpol, son del tipo de doble casco, por su menor sensibilidad a sufrir daños y provocar vertidos accidentales.

Además del transporte por oleoducto, este tipo de buque son el único medio rentable para el transporte de grandes cantidades de crudo, a pesar de que algunos han provocado grandes catástrofes ecológicas al hundirse y provocar derrames en la mar. Los desastres más conocidos son: *Deepwater Horizon (México, 2010), Hebei Spirit (Corea del Sur, 2007), Prestige (Galicia, 2002), Amoco Cádiz (Francia, 1978), Urquiola (Galicia, 1976)*.

Los petroleros se clasifican en:

- Shuttle Tanker (lanzadera): repiten continuamente el trayecto de ida y vuelta desde pozo (instalación offshore) a la refinería en tierra. Su capacidad es de 80 a 120 mil toneladas de peso muerto.

- Coastal Tanker (costeros): son usados para trayectos costeros, cortos y cautivos. Presentan una capacidad de hasta 16.5 mil toneladas.

- General Purpose Tanker (Multipropósito): operan en tráficos diversos con una capacidad de 16.5 a 25 mil toneladas.

- Handy Size Tanker: sus áreas de operación son el Caribe, este de los EEUU, Mediterráneo y el Norte de Europa. Tienen una capacidad de 25 a 45 mil toneladas.

- ULCC (Ultra Large Crude Carrier): con capacidad de más de 500 mil toneladas.

- VLCC (Very Large Crude Carrier): con una capacidad de más de 200 mil toneladas.

- Suezmax, indica navíos que pueden navegar por el canal de Suez, con una capacidad entre 125 y 200 mil toneladas.

- Aframax, deriva de Average Freight Rate Assessment, con una capacidad entre 80 y 125 mil toneladas.

- Panamax, hace referencia a navíos que transitan por el Canal de Panamá, su capacidad es de 50 a 79 mil toneladas.

2.2 Diferencia entre petroleros y otros buques de carga.

Las diferencias más relevantes en comparativa con los demás buques de carga se pueden agrupar en los siguientes aspectos:

- Resistencia de la estructura: en los petroleros es soportada por el doble fondo, forro exterior y mamparos, en oposición a los demás buques de carga que la soportan las cubiertas en el espacio de bodegas. La estructura de los barcos de crudo debe ser más resistente ya que, además, en aguas agitadas deben soportar las fuerzas de inercia que actúan en mamparos y costados.

- Estanqueidad al petróleo: los tanques de carga del petrolero deben de ser estancos al petróleo y a los gases producidos por este ya que al mezclarse con el aire son de carácter explosivo. Por esta razón, se debe evitar que los circuitos eléctricos de dispongan a través de los tanques o cámara de bombas.

- Variación del volumen de la carga: si la temperatura aumenta un 10 %, el volumen de la carga también aumenta, en este caso, un 1%. Se debe evitar el llenado en exceso de los tanques para que no existan reboses; pero también, se debe procurar no dejarlos demasiado vacíos por la inestabilidad generada a causa de esto y porque el espacio libre se completa con gases explosivos.

- Sistema de bombas de carga y descarga de petróleo: las bombas son turbobombas de gran capacidad y están accionadas por un motor eléctrico o por vapor. La cámara de bombas se suele situar a popa de los tanques de carga, permitiendo así el movimiento del petróleo.

- Ventilación: es necesario expulsar los vapores de petróleo de los cóferdams y cámara de bombas.

2.3 Características generales que deben cumplir los petroleros

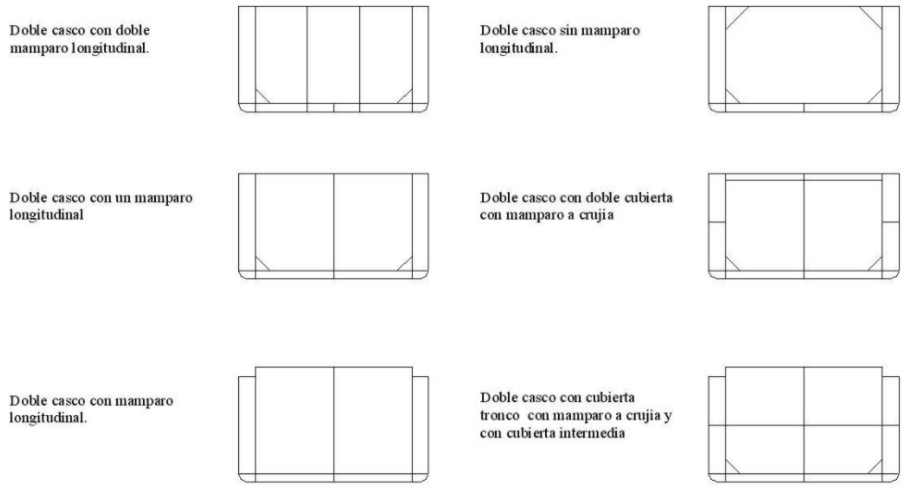
Como ya se ha mencionado en el apartado anterior, actualmente los petroleros construidos son de doble fondo y con tanques de lastre separados, lo que evita las

mezclas oleosas, que quedan limitadas a las propias del lavado con crudo de los espacios de carga.

En la conferencia Marpol-78 se presentó que el propio crudo es el mejor fluido para la limpieza del crudo residual y de las incrustaciones que se originan en los tanques de carga tras un cierto período de uso.

Los petroleros de nueva construcción dispondrán los tanques de carga protegidos por medio de tanques de lastre o espacios que no sean tanques de carga o combustible. Es decir, contarán con doble casco. Es opcional el planteamiento del proyecto del buque con cubierta intermedia.

Lloyd's Register propone las siguientes secciones maestras en el diseño de nuevos petroleros:



- A excepción de los que llevan cubierta intermedia que puede no llevar doble fondo, todos disponen de doble casco y doble fondo.
- La colocación del doble fondo provoca la elevación del centro de gravedad derivando en problemas de estabilidad en el momento de realizar la carga.

La carga de un petrolero se puede clasificar como:

- Pesada o sucia (crudo, asfalto, fuel-oil residuales): son transportadas por tanqueros de gran porte como Aframax, VLCC y ULCC.
- Ligera o limpia (productos refinados: gasolinas naturales, gasolina para automóviles, keroseno, entre otros): son transportadas por buques de menor tonelaje.

En caso de que el producto transportado sea pesado, de gran viscosidad, es necesario el previo calentamiento de los tanques de carga para dar más fluidez a la carga y facilitar también su descarga. El llenado y vaciado se hace por el fondo.

Una mejora en la repartición de los espacios de este tipo de buque proviene de la aparición de los tanques de decantación "Slop", cuyo fin es retener los restos de las

mezclas provenientes del lavado de los tanques de carga. Normalmente se colocan dos a popa de los tanques de carga.

Cuando la propulsión es Diésel, las turbobombas de carga y calefacciones de tanques son accionadas con una o dos calderas de mecheros agregadas al motor.

Para la eliminación de los vapores de petróleo y gases explosivos que perduran en los tanques tras su vaciado, se usan equipos de gas inerte. El gas inerte, CO_2 principalmente, proviene del tratamiento de los gases de escape de los motores auxiliares.

Para inspecciones o reparaciones de los tanques de carga, es necesaria su desgasificación. Para ello, se vacía el tanque y luego se le inyecta vapor con los tanques bien cerrados; transcurridas unas cinco horas, se abren y se libera el vapor arrastrando a los gases. Finalizado este proceso, se llenan los tanques con agua hasta rebosar, así si existen gases remanentes, estos se ven arrastrados por el agua en grandes burbujas. Para concluir la desgasificación, se vacían los tanques y se ventilan por un par de días con aire hasta que no haya gases y se pueda entrar en ellos con cierto grado de seguridad.

2.4 Operaciones en un petrolero

Este tipo de buques suponen un alto riesgo medioambiental debido al tipo de carga y cantidad de esta que transportan. Además, el simple hecho de operación del petrolero hace que contamine, por lo que se crearon convenios en el ámbito de la IMO (International Maritime Organization) y otros para reducir, en la medida de lo posible, la contaminación marítima.

A mediados del siglo pasado, se publicaba el primer acuerdo internacional para la prevención de la contaminación del mar por hidrocarburos, que obligó a montar en los buques separadores de agua-aceites procedentes de las descargas de sentinas.

Los principales factores de contaminación procedentes de este sector son:

- En las terminales para buques: prácticas operacionales inadecuadas, derrames o sobrellenados.
- En los propios buques pueden darse: accidentes como fallos estructurales, colisiones, explosiones, incendios o hundimientos; o también fallos en la operativa durante la limpieza de tanques o descarga de sentinas.

La limpieza de los tanques es de especial mención ya que constituía el principal causante de contaminación de los petroleros. Para combatir este hecho, se adoptan medidas como los tanques de lastre segregado y lavado de crudo pudiendo hacer de vez en cuando un aclarado con agua salada caliente.

En la actualidad, se sigue el método siguiente: el buque parte de la terminal de descarga en la situación de lastre separado. En un momento determinado del trayecto se hace la limpieza de los tanques de crudo con las máquinas de lavado con crudo que, con su acción, deben cubrir la totalidad de la superficie a limpiar. La mezcla de crudo y residuos es bombeada a los tanques de decantación que hacen también de tanques de

residuos; la mezcla resultante es completada con crudo en la terminal de carga (Load on Top) y este conjunto completo se descarga en la refinería.

2.5 Limpieza de tanques con crudo

A consecuencia de los crudos, una gran cantidad de sedimentos es generada (alrededor del 0.5% de la carga total). Estos sedimentos constituidos principalmente por arcillas, fangos, láminas de óxidos, arena y parafinas, se depositan en toda la estructura del buque.

Las ventajas del lavado con crudo son:

- Menor contaminación del mar.
- Económicamente más rentable.
- Sencillez operacional: el achique de tanques y su apurado final se realiza con mayor facilidad y en un período de tiempo más breve al no haber residuos que obstruyan las groeras.
- Equipo empleado queda reducido.
- Disminución de la corrosión al ser menor el empleo de agua salada y el porcentaje de oxígeno.

Hoy por hoy, gracias a los tanques de lastre segregados, la contaminación se vio muy reducida al suprimirse las operaciones de enjuague con agua para lastre limpio. Estas sólo se hacen en ocasiones puntuales como reparaciones o inspecciones, ya mencionadas.

Se han desarrollado dos destrezas distintas para el proceso de lavado de tanques:

- Lavado en una etapa: se limpia el tanque en su totalidad, de forma continuada y sin interrupciones hasta alcanzar el objetivo. Para esto, el tanque debe de estar seco, sin permitir acumulaciones de líquido durante el proceso.
- Lavado en dos o más etapas: la operación tiene interrupciones de duración igual al tiempo de descarga de los tanques a limpiar, aprovechando las zonas que quedan libres de crudo para efectuar el lavado. Se recomienda el uso de máquinas programables para reducir así los costes.

2.6 El gas inerte

Como ya se ha explicado, el gas inerte es una mezcla de gases en la que el contenido de oxígeno es tan bajo que no es posible la combustión. Este es obtenido de la combustión de una caldera, de la exhaustación de un motor o desde un tanque de almacenamiento.

La principal función de este gas es evitar explosiones en los tanques al desplazar el aire de ellos; también es usado para la ventilación de tanques de carga y evitar sobrepresiones o vacío.

Antes de ser distribuido a los tanques, este ha de ser enfriado y purificado para eliminar las partículas sólidas y corrosivas que lo componen.

El buque llega a la fase de descarga con los tanques inertizados y la planta de gas inerte comprobada. El suministro de gas inerte se inicia antes de comenzar la descarga para así subir la presión en los tanques y evitar la entrada de aire en estos.

Previamente al inicio de lavado de los tanques, el porcentaje de oxígeno en ellos debe de ser comprobado y asegurarse de que es inferior al 5%. En caso de una falta en la planta de gas inerte, de que el porcentaje de oxígeno sea superior al anteriormente mencionado o si la presión en el interior del tanque es inferior a la atmosférica, se interrumpen las operaciones de lavado.

3 INTRODUCCIÓN: OBJETIVO Y ALCANCE DEL PROYECTO

El buque que se proyectará en este trabajo es uno para el transporte de un gran volumen de crudo, un petrolero de crudo (VLCC), cuya característica principal es su capacidad de carga máxima de 275000 toneladas de peso muerto.

Se considera que el buque a diseñar operará desde África (Nigeria, Libia, Angola...) a Europa; por lo que no tendrá limitaciones de canales u respecto a las condiciones meteorológicas. A continuación, se muestra una imagen con los principales países productores de petróleo:

Los cálculos de dimensionamiento del buque se desarrollarán en el presente cuaderno usando como procedimiento un método estadístico. Es decir, partiendo de la información de una base de datos de barcos parecidos al buque objeto de diseño (no anteriores al 2010, por cuestión de cumplimiento de reglamentos y normas actuales), se intentará ajustar sus dimensiones con la mayor exactitud posible gracias al volumen de datos adquiridos con anterioridad.

Se prevé que la manga del buque esté dividida en 3 bodegas tanques de carga (babor, estribor y central), tomando como referencia el buque Hunter Atla de la base de datos. Las bodegas ocuparán prácticamente la totalidad de la eslora del buque a excepción de la cámara de máquinas y cámara de bombas, ambas en popa.

El buque presentará doble fondo con el que podrá ser lastrado en caso de que sea necesario.

La propulsión se llevará a cabo con un motor diésel acoplado a la hélice de paso fijo con la que se moverá el buque. Se deben alcanzar 15.5 nudos en condiciones de servicio.

La tripulación estará formada por 36 personas con las asignaciones generales de:

- 1 Capitán
- 1 Jefe de máquinas
- 6 Oficiales
- 28 Marineros

Todos dispondrán de camarotes individuales con aseos privados; además, capitán, jefe de máquinas y oficiales deben contar con despachos.

Los locales de servicio serán:

- Puente de Gobierno.
- Oficina de carga.
- Sala de estar para oficiales.
- Sala de estar tripulación.
- Sala de Juntas.
- Enfermería de tres plazas.
- Comedor.
- Cocina.
- Gambuza seca con armarios frigoríficos.
- Aseo público en cubierta.
- Lavandería.

El buque estará dotado de un equipo de tratamiento de aguas residuales, completamente automático que funcionará dependiendo de los niveles del tanque.

4 BASE DE DATOS

Tras haber obtenido las características y requisitos previos a la actividad (RPA) del buque a proyectar, la base de datos con buques similares ha sido elaborada.

La confección de esta base de datos ha sido posible gracias, principalmente, a revistas como “Significant Ships” de diversos años, que se han utilizado como material de apoyo y fuentes de información, y donde se han hallado navíos recientes de características similares al buque a desarrollar en lo que a sus características particularidades se refiere.

A continuación, se muestra la base de datos resultante del proceso de adquisición de datos:

Nombre buque	Año	Peso Muerto (dwt)	Capacidad carga (m3)	Lpp (m)	Lt (m)	D (m)	B (m)	Tmax (m)	Tsc (m)
ASTIR LADY	2011	50285	54602	174	183		19,1	11	13,06
HUA YUN	2011	40522	46518	174	182	17,3	32,2	11	
MAERSK SARA	2011	323190	352,833	319	332	30,5	60	21	22,6
SAMCO AMAZON	2011	314250	352,5	319	333,08	30,4	60	21	22,6
SIFA	2011	316400	351200	319	333	30,4	60	21	22,6
SPYROS K	2011	158000	170000	264	274,2	23,1	48	16	17,15
ENEOS OCEAN	2014	312181	350623	334,5	339,5	28,5	60		21,09
PEGASUS VOYAGER	2014	155720	178600	265,6	275,6	23,7	48	17	17
GENER8 HECTOR	2016	298438,9	344826,44	321,9	333	29,5	60	20,5	21,6
MILOS	2016	157460	170000	267	277,27	23,1	48	16	17,15
TRINITY	2016	158734	173579	263,14	274,17	23,1	48	16	17,15
AMJAD	2017	298886	342059,6	322	332,97	29,4	60	20,5	21,6
AQUAPAMPERO	2017	113000	126000	234	244	21,8	43	15,2	15,2
BLACK DUCK	2017	7894,8	8072,8	112	119	10,65	20,4	6,7	6,7
ELANDRA EAGLE	2017	157300	174000	267	277	23,1	48	16	17,15
GUANG ZHOU WAN	2017	13300	12800	138	145,9	11,8	22,6		7,9
OTTOMAN COURTESY	2017	149999	178500	258	269,08	25,1	46	16,2	17,8
V.TRUST	2017	301100	345000	330	336	29,4	60	20,5	21,7
ALMI ATLAS	2018	315221	357777,8	330	336,08	30,3	60	21	22,6
AMPHION	2018	320784	360000	326,4	333	30,5	60		22,8
DHT BRONCO	**2018**	**317975**	**353900**	**327**	**333**	**30,4**	**60**	**21**	**22,6**
EAGLE BARCELONA	2018	113000	130000	243	250	21,2	43,8	13,6	15,1
FLAVIN	2018	115125	133100	241,6	249,9	21,5	44	13,6	15
IBERIAN SEA	2018	114218	130200	239	249,8	21,35	44	13,6	15,1
MORVIKEN	2018	157610	170000	267	274,3	23,3	49		17,2
DIJILAH	2019	320500	354000	326,4	333	30,5	60	21	22,8
EAGLE BRASILIA	2019	132900	129000	243	250	21,2	43,8	13,6	15,1
HUNTER ATLA	**2019**	**300300**	**341870**	**330**	**336**	**29**	**60**	**20,5**	**21,6**
NISSOS RHENIA	2019	318953	355800	327	332,995	30,4	60	21	22,6

Δ (t)	Cb	Peso Rosca (t)	P (kW)	rpm de la P	Velocidad de servicio (knots)	Motor ppal	Combustible	Consumo
			9480	127	15,29	1	HFO	
			9960	124	15,51	1	HFO-MDO	36,7 t/día
368,262	0,829	450,72	29340	74	16,28	1	HFO-MDO	104 t/día
364000	0,8201		31640	80	16,6	1	HFO-MDO-MGO	107 t/día
			31640		15,5	1	HFO-MDO	104,4 t/día
			18660	91	15,7	1	HFO-MDO-MGO	69,3 t/día
		159579	23620	65	16,5	1		
			21840		15	1	HFO-MDO	
343838,9	0,797	45400	17200	57,2	14,8	1	HFO-MGO	67,58 t/día
			15088	71,8	14,2	1	HFO-MGO	40,4 t/día
183887	0,826	25153	14520	73,8	14,2	1	HFO-MDO-MGO	165,4 g/kW*hr
132524	0,7208	43756	24000		14,72	1	HFO	169,17 g/kW*hr
			12420		14,5	1	HFO-MGO	41,1 t/día
			3400		13,24	1	HFO-LSMGO	10,5 t/día
			15088		14,2	1	HFO-MDO-MGO	38,6 t/día
19800	0,7837	6500	4320		14	1	HFO-MDO-MGO	14,8 t/día
			13900		13	1	HFO-MGO	
			25600		15,8	1	HFO-MGO	
138911	0,7036	46974	26000		15,2	1	HFO	169,59 g/kW*h
			26890	72	14,5	1	HFO-MDO	
			24500	**66,1**	**14,8**	**1**	**HFO-MGO**	
			11,2	77	14,5	1	HFO-MDO	
134845	0,8313	19719	12400		14,5	1	HFO-MDO	45,66 t/día
			13500	87	14,5	1	HFO-MDO	39 t/día
			16400	72	14,5	1	HFO-MDO	
			26890	72	14,8	1	HFO-MGO	64,6 t/día
112900	0,796	20000	11200		14,5	1	HFO-MDO-LNG	38,2 t/día
			24510	**66,4**	**14,8**	**1**	**HFO-ULSFO-LSMGO**	**62,9 t/día**
			33250	84	14,4	1	HFO-ULSFO-MGO	65,2 t/día

Esta base de datos facilitará el hallazgo de forma aproximada, de las dimensiones del buque a proyectar en base a un análisis de gráficas con la regresión lineal de parámetros de los buques de referencia.

De la tabla anteriormente expuesta, se obtienen las siguientes relaciones:

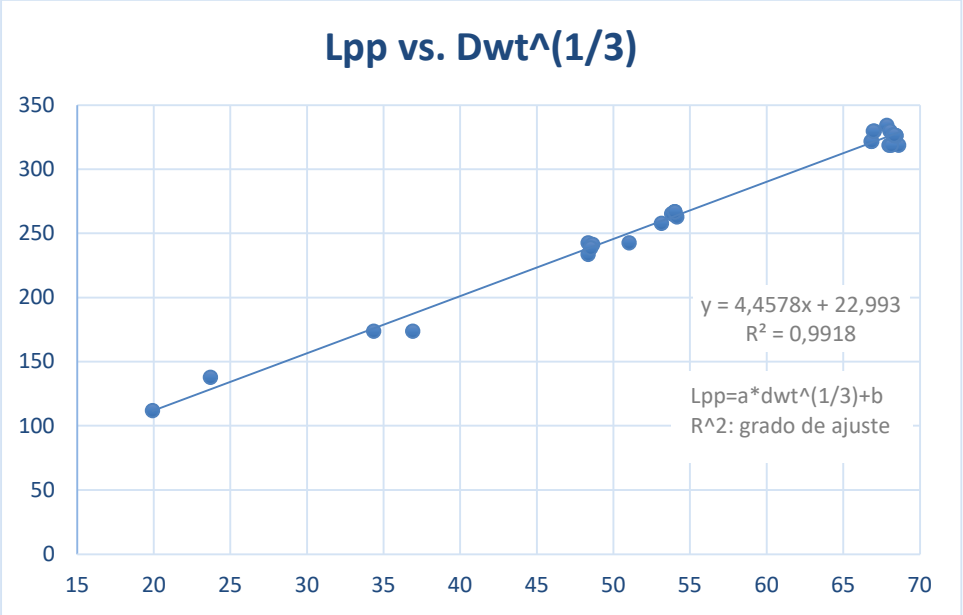
Lpp/B	B/Lt	B/Tsc	Lpp/Tsc	Lpp/D	Tsc/D	B/D
9,10994764	0,10437158	1,462480858	13,323124			
5,40372671	0,17692308			10,0578035		1,86127168
5,31666667	0,18072289	2,654867257	14,1150442	10,4590164	0,740983607	1,96721311
5,31666667	0,1801369	2,654867257	14,1150442	10,4934211	0,743421053	1,97368421
5,31666667	0,18018018	2,654867257	14,1150442	10,4934211	0,743421053	1,97368421
5,5	0,1750547	2,798833819	15,393586	11,4285714	0,742424242	2,07792208
5,575	0,17673049	2,844950213	15,8605974	11,7368421	0,74	2,10526316
5,53333333	0,17416546	2,823529412	15,6235294	11,2067511	0,717299578	2,02531646
5,365	0,18018018	2,777777778	14,9027778	10,9118644	0,73220339	2,03389831
5,5625	0,17311646	2,798833819	15,5685131	11,5584416	0,742424242	2,07792208
5,48208333	0,17507386	2,798833819	15,3434402	11,391342	0,742424242	2,07792208
5,36666667	0,18019641	2,777777778	14,9074074	10,952381	0,734693878	2,04081633
5,44186047	0,17622951	2,828947368	15,3947368	10,733945	0,697247706	1,97247706
5,49019608	0,17142857	3,044776119	16,7164179	10,5164319	0,629107981	1,91549296
5,5625	0,1732852	2,798833819	15,5685131	11,5584416	0,742424242	2,07792208
6,10619469	0,15490062	2,860759494	17,4683544	11,6949153	0,669491525	1,91525424
5,60869565	0,17095288	2,584269663	14,494382	10,2788845	0,709163347	1,83266932
5,5	0,17857143	2,764976959	15,2073733	11,2244898	0,738095238	2,04081633
5,5	0,17852892	2,654867257	14,6017699	10,8910891	0,745874587	1,98019802
5,44	0,18018018	2,631578947	14,3157895	10,7016393	0,747540984	1,96721311
5,45	0,18018018	2,654867257	14,4690265	10,7565789	0,743421053	1,97368421
5,54794521	0,1752	2,900662252	16,0927152	11,4622642	0,712264151	2,06603774
5,49090909	0,17607043	2,933333333	16,1066667	11,2372093	0,697674419	2,04651163
5,43181818	0,17614091	2,913907285	15,8278146	11,1943794	0,707259953	2,06088993
5,44897959	0,17863653	2,848837209	15,5232558	11,4592275	0,738197425	2,10300429
5,44	0,18018018	2,631578947	14,3157895	10,7016393	0,747540984	1,96721311
5,54794521	0,1752	2,900662252	16,0927152	11,4622642	0,712264151	2,06603774
5,5	0,17857143	2,777777778	15,2777778	11,3793103	0,744827586	2,06896552
5,45	0,18018289	2,654867257	14,4690265	10,7565789	0,743421053	1,97368421

5 CÁLCULO PRELIMINAR DE LAS DIMENSIONES

En este apartado, se presentan las gráficas y fórmulas empleadas para el dimensionamiento preliminar del buque proyectado, obtenidas estas últimas mediante curvas de regresión lineal; así es posible el cálculo de las variables deseadas.

5.1 Estimación de la Eslora entre Perpendiculares (Lpp)

El tonelaje de peso muerto es un dato de la RPA (en el caso a tratar es de 275000 TPM) a partir del cual se calculará la Lpp. Se representa Lpp frente a DWT ^(1/3) de los buques de referencia:



Según la curva de regresión lineal, se puede observar que el coeficiente de determinación (R^2) es 0.9918, valor bastante alto (próximo a 1), lo cual se puede interpretar como que la eslora entre perpendiculares y el peso muerto tienen una alta correlación.

Se obtiene, de la gráfica anterior, la línea de tendencia, cuya ecuación viene dada por:

$$Lpp = 4.4578 * (Dwt)^{\frac{1}{3}} + 22.993$$

Con el valor de DWT=275000 se halla que la eslora entre perpendiculares es:

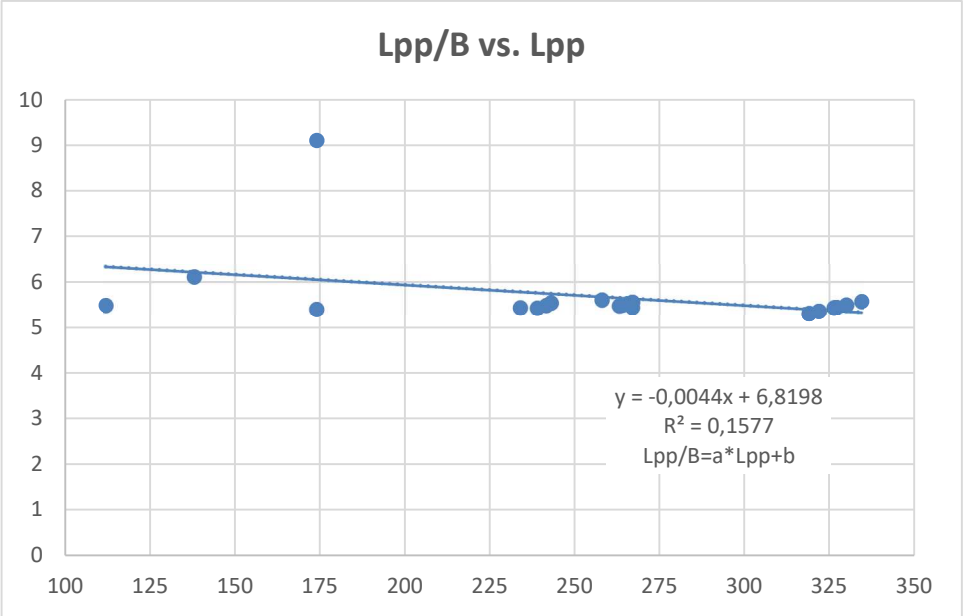
$$L_{pp} = 312.88\, m$$

Esta eslora entre perpendiculares será la empleada como preliminar en las operaciones que se muestran a continuación.

5.2 Estimación de la Manga (B)

Para calcular la manga, primero será necesario obtener la representación de la relación eslora/manga del buque en relación con la eslora.

A continuación, representando la relación $\frac{L_{pp}}{B}$ frente a la L_{pp}:



De la gráfica y con la línea de tendencia, se obtiene la siguiente ecuación:

$$\frac{L_{pp}}{B} = -0.0044 * L_{pp} + 6.8198$$

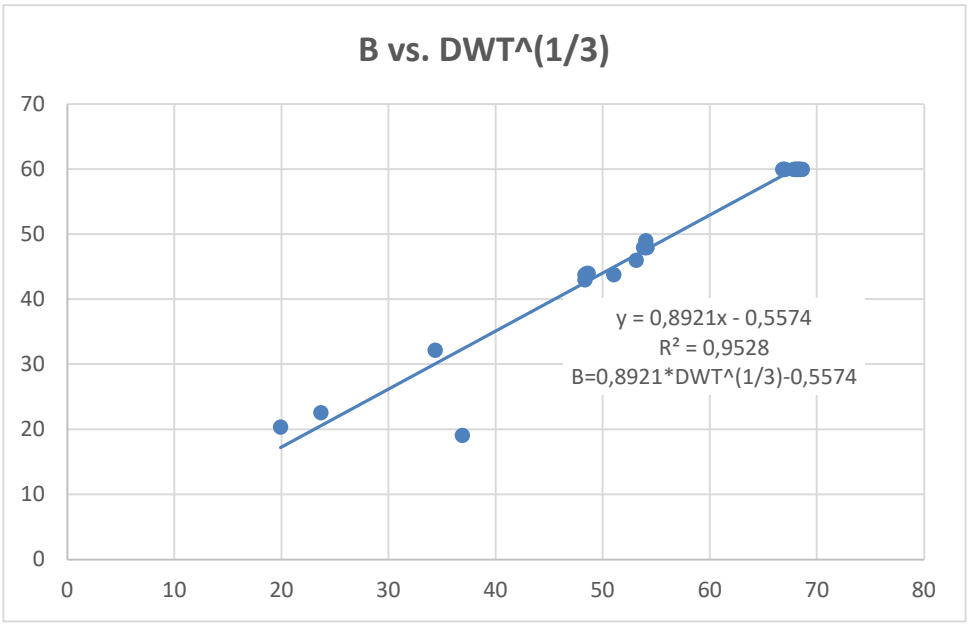
Del apartado anterior es sabido que $L_{pp} = 312.88\, m$. Con ello se deduce que la relación eslora/manga es:

$$\frac{L_{pp}}{B} = 5.44$$

A partir de este valor será de fácil deducción la dimensión preliminar de la manga:

$$B = \frac{L_{pp}}{5.44} = 57.48\, m$$

Para obtener una estimación aproximada de la manga, también se podría emplear otro método, como la representación la B en función de DWT^(1/3):



De aquí resulta la línea de tendencia que corresponde a la siguiente ecuación:

$$B = 0.8921 * DWT^{\frac{1}{3}} - 0.5574$$

De los requisitos previos de actividad es sabido que DWT= 275000, así se puede obtener un valor de B:

$$B = 57.45\ m$$

Como se observar en la gráfica anterior, la línea de tendencia obtenida por el segundo método presenta un coeficiente de determinación mucho más próximo a la unidad que la obtenida por el primer método, por lo que el resultado obtenido se aproximaría más al valor real de nuestra manga empleando el segundo método.

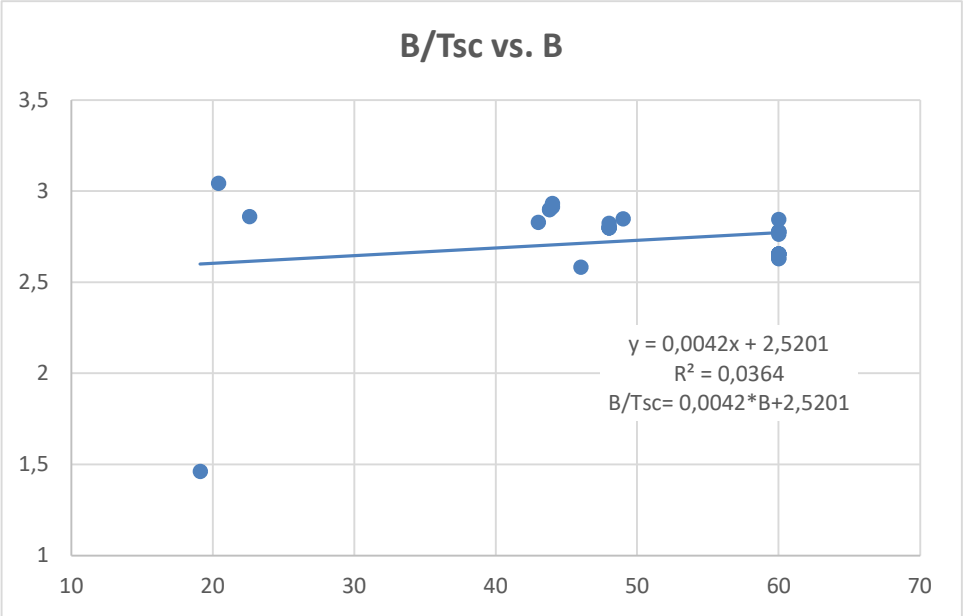
Para los cálculos a desarrollar en este cuaderno, es empleado un valor medio de ambas estimaciones, es decir:

$$B = \frac{57.48 + 57.45}{2} = 57.47\ m$$

5.3 Estimación del Calado (T)

Para conseguir el calado es empleada una metodología parecida a la que ya se ha utilizado para averiguar la manga. Se requiere, en este apartado, de dos relaciones entre dimensiones y hallar con cada una de ellas el calado. La media entre ambas medidas se tomará como el valor preliminar del calado.

Primero es representada la relación $\frac{B}{T}$ sobre B:



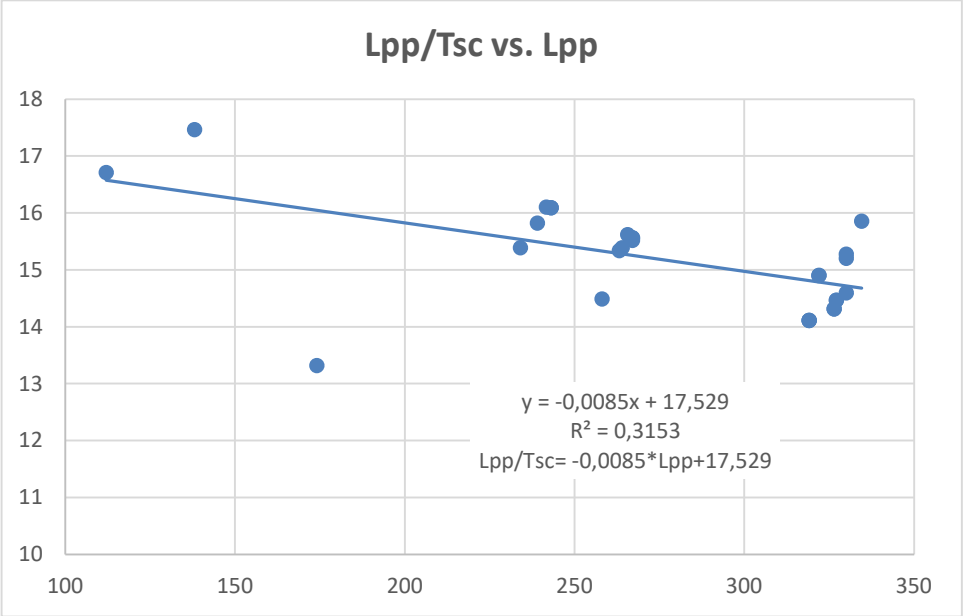
La ecuación resultante de esta relación es:

$$\frac{B}{T_{SC}} = 0.0042 * B + 2.5201$$

Sabiendo que $B = 57.47\ m$, se extrae:

$$T_{SC1} = 20.81\ m$$

Se figura, ahora, $\frac{L_{pp}}{Tsc}$ sobre L_{pp}:



La ecuación recabada de esta gráfica es:

$$\frac{L_{pp}}{T_{SC}} = -0.0085 * Lpp + 17.529$$

Sabiendo que $L_{PP} = 312.88\, m$:

$$T_{SC2} = 21.04\, m$$

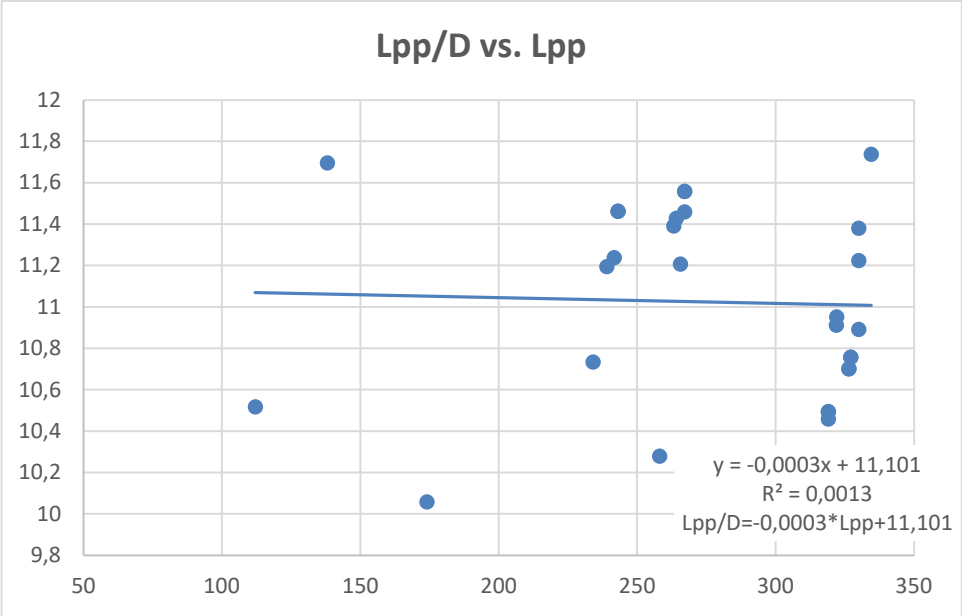
El Calado T preliminar resultante para el buque proyecto es:

$$T = \frac{T_{SC1} + T_{SC2}}{2} = 20.93\, m$$

5.4 Estimación del Puntal (D)

De forma similar al calado, el puntal se obtendrá evaluando las dimensiones proporcionales del barco a tratar y haciendo la media de los resultados obtenidos.

Representando la relación $\frac{L_{pp}}{D}$ frente a L_{pp}:



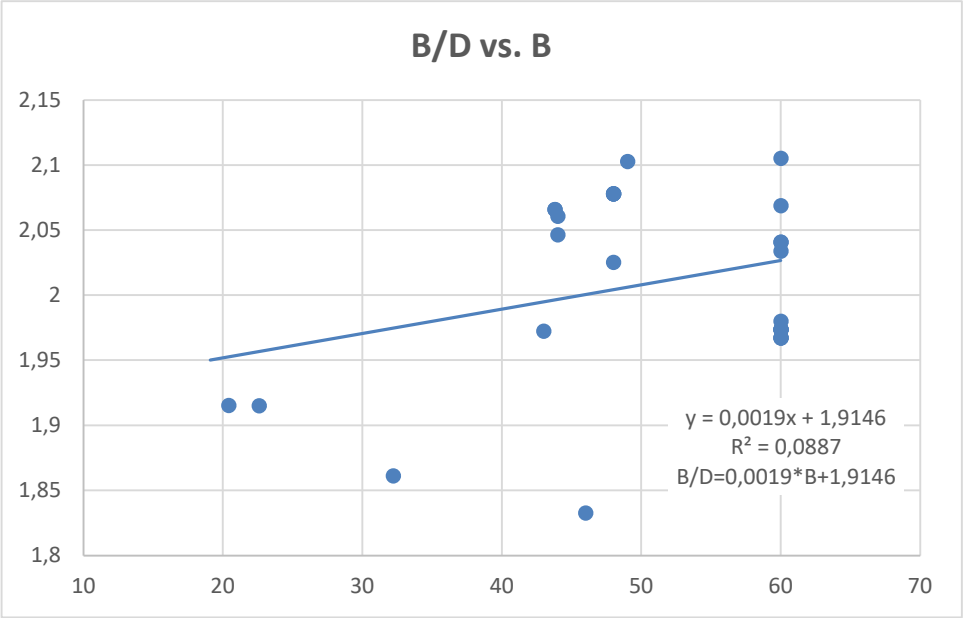
La ecuación obtenida en esta gráfica es la siguiente:

$$\frac{Lpp}{D} = -0.0003 * Lpp + 11.101$$

Sabiendo que $L_{PP} = 312.88\, m$,

$$D1 = 28.42\, m$$

De manera parecida, es posible la obtención de un valor aproximado de calado mediante la representación de la relación $\frac{B}{D}$ frente a B:



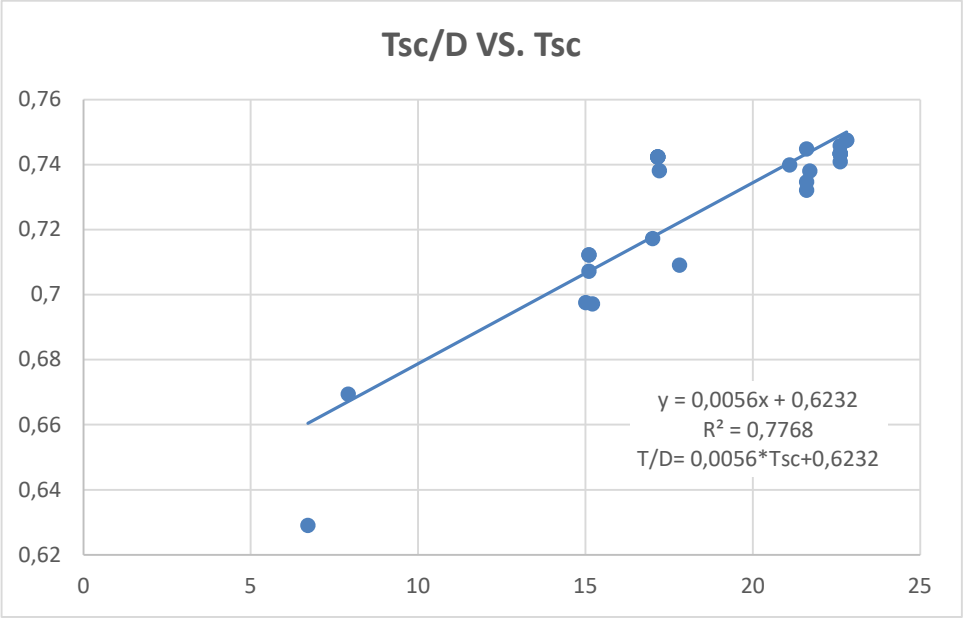
Se extrae la siguiente ecuación:

$$\frac{B}{D} = 0.0019 * B + 1.9146$$

Como es sabido que $B = 57.47\ m$,

$$D2 = 28.40\ m$$

Con una metodología similar, se puede representar la relación de $\frac{T}{D}$ frente a T para la obtención del valor aproximado de nuestro puntal:



De la gráfica anterior, resulta la siguiente ecuación:

$$\frac{T}{D} = 0.0056 * T + 0.6232$$

Como se sabe que $Tsc = 20.93\ m$,

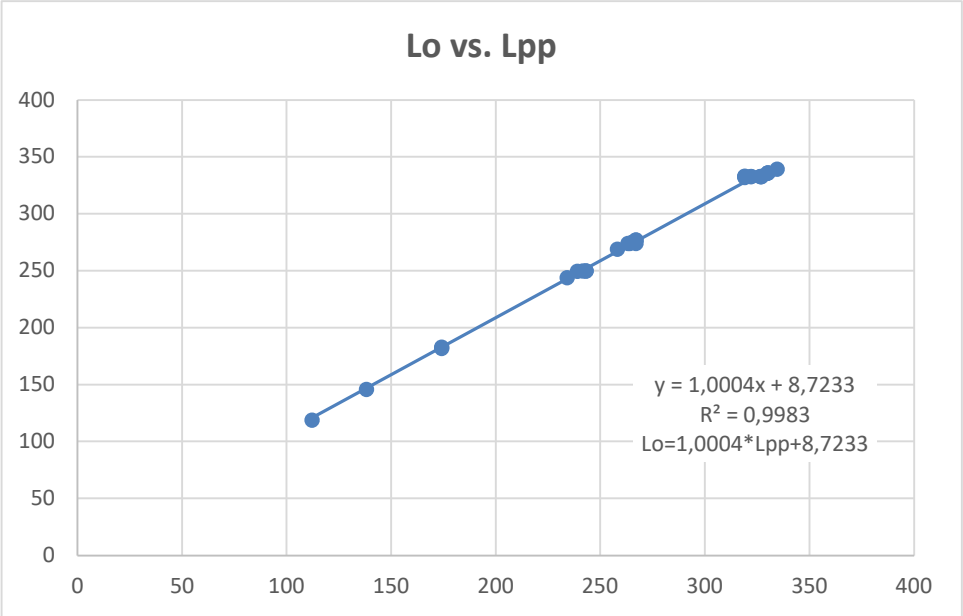
$$D3 = 28.26\ m$$

Haciendo la media entre los tres resultados obtenidos se deduce el calado D del buque a proyectar:

$$D = \frac{D1 + D2 + D3}{3} = 28.36\ m$$

5.5 Estimación de la Eslora absoluta (Lo)

Usando métodos similares a los anteriores y para completar con mayor exactitud el trabajo a realizar, se puede averiguar cuánto resulta la eslora absoluta (Lo) representándola respecto a la eslora entre perpendiculares (Lpp):



Con la ecuación $Lo = 1.0004 * Lpp + 8.7233$ y sabiendo el valor de $Lpp = 312.88\ m$:

$$Lo = 321.73\ m$$

5.6 RESULTADOS OBTENIDOS

Para concluir, las dimensiones estimadas por medio de las regresiones lineales, obtenidas para un VLCC de 275000 TPM, son:

Lpp (m)	***Loa (m)***	***B (m)***	***T(m)***	***D (m)***	***Lpp/B***	***B/T***	***B/D***	***T/D***	***Lpp/D***	***Lpp/T***
312.88	321.73	57.47	20.93	28.36	5.44	2.75	2.03	0.74	11.03	14.95

De las dimensiones obtenidas mediante las regresiones lineales, se han hallado las relaciones que se muestran en la tabla anterior y cuya importancia se explica a continuación.

- Relación L/B

  Un valor elevado de esta relación significa que la resistencia al avance del buque a proyectar es menor, lo que a nivel práctico y económico supone el montaje de un motor propulsor de menor tamaño con el ahorro en consumo de combustible correspondiente. En la otra mano, el aumento de este dígito supone un mayor peso de acero, conduciendo a una mayor valoración económica del buque a tratar.

- Relación B/T y B/D

  Este valor está relacionado con la estabilidad del buque. Si el resultado es un número elevado significa que el buque a proyectar tiene una mayor estabilidad inicial (al aumentar la manga el KM es mayor); en la cara opuesta, esto supone una mayor resistencia al avance del barco. En términos generales, a no ser que existan unas condiciones de estabilidad muy exigentes, el objetivo será que esta relación sea lo más baja posible favoreciendo así la resistencia al avance del buque a tratar.

- Relación T/D

  Proporciona información referente al francobordo.

- Relación L/D

  Esta relación hace referencia a la resistencia del buque, sobre todo a su resistencia a la flexión. Esta relación está limitada a un valor máximo de 15, en caso de superarse el buque será considerado como peligroso.

Con estos resultados, queda definido el volumen cúbico inicial del buque en cuestión:

$$Lpp * B * D = 509975.71\ m^3$$

Para poder finalizar la definición de los parámetros preliminares del buque a proyectar, es necesario considerar otras magnitudes determinadas en la RPA.

En el caso a tratar, la velocidad dada en la RPA es de 15.5 nudos en condiciones de servicio, lo que equivale a:

$$v(\frac{m}{s}) = v\ (nudos) * 0.5144 = 7.97\ (\frac{m}{s})$$

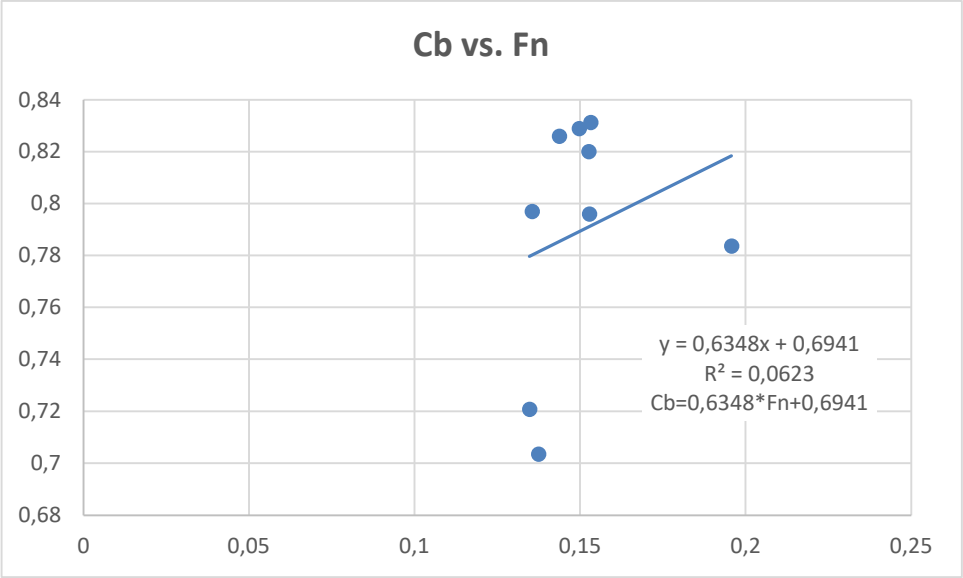
Con los datos anteriores, se puede obtener el Número de Froude (Fn):

$$Fn = \frac{v(\frac{m}{s})}{\sqrt{g * Lpp}} = \frac{7.97}{\sqrt{9.81 * 312.88}} = 0.14$$

5.7 Cálculo del Coeficiente de Bloque

Este indicador es considerado elemental para la obtención de las formas del buque, ya que influye directamente sobre la resistencia al avance del mismo, sobre la capacidad de carga y también, aunque en un rango menor, sobre la estabilidad de este.

Contemplando los buques de los que se dispone en la base de datos, se puede observar que tan solo se poseen nueve buques de los que se conoce el desplazamiento y, por tanto, el coeficiente de bloque. Esos son los únicos datos de los que se puede partir y con los que se puede trabajar, aunque no resultarán en una correlación de gran exactitud. Se representan entonces Cb frente a Fn de esos 9 buques para poder así obtener el coeficiente de bloque del barco proyectado:



Empleando la fórmula obtenida $Cb = 0.6348 * Fn + 0.6941$ y sabiendo que $Fn = 0.14$; es extraído el valor inicial de Cb:

$$Cb\ inicial = 0.78$$

Se puede comprobar el coeficiente de bloque obtenido mediante las formulaciones siguientes, sacadas del temario de la asignatura de Proyectos del Buque y Artefactos Marinos I:

- Propuesta por Towsin en un informe de Watson & Gilfillan:

$$Cb = 0.70 + \frac{1}{8}\text{atan}\left(\frac{23 - 100 * Fn}{4}\right) = 0.84$$

Si la misma fórmula es aplicada en el buque de referencia “Hunter Atla”, el Cb obtenido es 0.847, por lo tanto, es correcto.

- Usando la fórmula de Minowsky:

$$Cb = 1.22 - 0.709 * \frac{V\left(\frac{m}{s}\right)}{\sqrt{L}} = 0.90$$

- Recomendada por Telfer para la serie 60 para cascos de tipo comerciante de un solo eje (el nuestro según la RPA):

$$Cb = 1.18 - 0.69 * \frac{V\left(\frac{m}{s}\right)}{\sqrt{L}} = \ 0.87$$

- Según el método de Munro-Smith el coeficiente de bloque para petroleros VLCC viene dado por la siguiente expresión:

$$Cb = 1.00 - 0.175 * \frac{v(nudos)}{\sqrt{Lpp}} = 0.85$$

- Usando el método Alexander, tenemos la siguiente expresión:

$$Cb = K - 0.5 * \frac{v(nudos)}{\sqrt{Lpp}}$$

Con $K = 1.33 - 0.54\frac{v\left(\frac{m}{s}\right)}{\sqrt{Lpp}} + 0.24 * (\frac{v(nudos)}{\sqrt{Lpp}})^2$

$$Cb = 0.83$$

Con los valores de coeficiente de bloque hallados, podemos extraer el valor medio que será considerado en este trabajo. Con lo cual:

Cb inicial	*0,785457646*
Cb Towsin	*0,841977233*
Cb Minowsky	*0,900413281*
Cb Telfer	*0,868977664*
Cb MunroSmith	*0,846651484*
Cb Alexander	*0,832739428*

$$Cb = \frac{0.78 + 0.84 + 0.90 + 0.87 + 0.85 + 0.83}{6} = 0.845 \simeq 0.84$$

El desplazamiento (Δ) viene dado por:

$$\Delta = 1.025 * Lpp * B * T * Cb = 326020.70\ t$$

5.8 Cálculo del Coeficiente de la Maestra

Tras haber calculado el Cb del buque a tratar, se puede proceder a la deducción del coeficiente de la maestra, necesario para completar la definición preliminar del barco y cuyo valor afecta directamente a la amplitud de la zona curva del casco en el pantoque.

Para ello se usan las metodologías siguientes, sacadas de los apuntes de la asignatura anteriormente mencionada:

- Benford, basada en la serie 60 para cascos de tipo comerciante de un solo eje (el nuestro según la RPA):

$$Cm = 0.977 + 0.085 * (Cb - 0.60) = 0.998$$

- Kerlen:

$$Cm = 1.006 - 0.0056 * Cb^{-3.56} = 0.996$$

Haciendo la media de los Cm anteriormente hallados, es alcanzado un valor resultante de:

$$Cm = 0.997$$

5.9 Cálculo del Coeficiente Prismático

El coeficiente prismático (Cp), también es un parámetro necesario para la completa definición del navío a proyectar; este viene dado por la siguiente relación:

$$Cp = \frac{Cb}{Cm} = 0.85$$

6 SELECCIÓN DE ALTERNATIVAS

En esta parte del desarrollo del proyecto, se trata de encontrar el buque cuya viabilidad económica para la construcción sea la más favorable. Para ello, por medio de una serie de variables, se generan diversas alternativas entre las cuales es escogida la opción óptima.

El requerimiento anterior a cualquier evaluación económica es la elección de la "Cifra de Mérito", cuyo fin es ejercer de fundamento para decidir cuál de las alternativas es la más favorable.

Existen distintos criterios basadas en diferentes procesos para la elección de alternativas, los más comunes son:

- Coste de Construcción (CC)
- Coste de Adquisición
- Inversión Total
- Costes de Operación
- Flete Requerido
- Tasa de rentabilidad Interna
- Tasa de recuperación del Capital Propio

6.1 Elección del criterio de evaluación económica

Para la ejecución del proyecto, las posibles dimensiones se toman en función de la Cifra de Mérito que en el caso a tratar es el Coste de Construcción (CC). Este presenta como ventaja su mayor fiabilidad frente a los demás, tiene un menor número de componentes aleatorios y su repercusión en el tiempo es prácticamente nula. En el proyecto a desenvolver sería de difícil elección cualquier otro criterio ya que no existe un armador que fije sus propios requisitos.

Entonces, para terminar de comprender el concepto de Cifra de Mérito, se puede decir que cuán menor sea el valor de esta, más favorable será la alternativa a tratar.

El proceso consiste en generar distintas opciones de dimensiones preliminares del buque en cuestión, a partir de la variación sistemática de sus parámetros fundamentales; se consideran entonces, sus dimensiones principales y los coeficientes. El CC es calculado para cada una de las alternativas obtenidas y se elige el que, cumpliendo los requisitos técnicos, presente un menor valor de coste de construcción.

El costo de construcción representa entre un 70-80% de aportaciones ajenas para el astillero y un 30-20% de valor añadido por el propio astillero. Estos valores varían en función del astillero y del tipo de buque.

6.2 Alternativas iniciales

Como ya se ha obtenido con anterioridad:

- Lpp=312.88 m
- B=57.45 m
- D=28.36 m
- T=20.93 m
- Fn=0.14
- Cb=0.845
- Cm=0.997
- Cp=0.85
- Δ=326020.70 t

6.2.1 Predicción preliminar de potencia

Para calcular la potencia preliminar se muestran dos métodos distintos pero cuyos resultados son similares. En ambos casos se usa como referencia el buque base "Hunter Atla":

- Primer método. Para ello es necesario:
  - Primero se debe calcular el Cr estándar del buque base, dado por la siguiente ecuación del libro "Ship Design for Efficiency and Economy":

$$C_{R,Standard} = c_{11} + c_{12}Fn + c_{13} * Fn^2 + Cb * (c_{21} + c_{22} * Fn + c_{23} * Fn^2) + Cb^2 * (c_{31} + c_{32} * Fn + c_{33} * Fn^2)$$

Las variables $c_{11}, c_{12}, c_{13}, c_{21}, c_{22}, c_{23}, c_{31}, c_{32}, c_{33}$ están recogidas en la siguiente tabla:

Table 6.10 Coefficients for typical resistance in Hollenbach's method

	Single-screw		*Twin-screw*
	design draft	*ballast draft*	
$b1$	−0.3382	−0.7139	−0.2748
$b2$	0.8086	0.2558	0.5747
$b3$	−6.0258	−1.1606	−6.7610
$b4$	−3.5632	0.4534	−4.3834
$b5$	9.4405	11.222	8.8158
$b6$	0.0146	0.4524	−0.1418
$b7$	0	0	−0.1258
$b8$	0	0	0.0481
$b9$	0	0	0.1699
$b10$	0	0	0.0728
c_{11}	−0.57420	−1.50162	−5.34750
c_{12}	13.3893	12.9678	55.6532
c_{13}	90.5960	−36.7985	−114.905
c_{21}	4.6614	5.55536	19.2714
c_{22}	−39.721	−45.8815	−192.388
c_{23}	−351.483	121.820	388.333
c_{31}	−1.14215	−4.33571	−14.3571
c_{32}	−12.3296	36.0782	142.738
c_{33}	459.254	−85.3741	−254.762
d_1	0.854	0.032	0.897
d_2	−1.228	0.803	−1.457
d_3	0.497	−0.739	0.767
e_1	2.1701	1.9994	1.8319
e_2	−0.1602	−0.1446	−0.1237
f_1	$F_n/F_{n,krit}$	$10 \cdot C_B \cdot (F_n/F_{n,krit} - 1)$	$F_n/F_{n,krit}$

Utilizando los valores dados para el calado de diseño de un buque de una hélice:

$$C_{R,Standard} = 0.852$$

El resultado obtenido es sustituido en la siguiente ecuación obtenida en la misma bibliografía:

$$C_R = C_{R,Standard} * \left(\frac{T}{B}\right)^{a1} * \left(\frac{B}{L}\right)^{a2} * \left(\frac{Los}{Lwl}\right)^{a3} * \left(\frac{Lwl}{L}\right)^{a4}$$

$$L = Lpp = Lwl$$

Con:

	$a1$	$a2$	$a3$	$a4$
Single-screw ship	−0.3382	0.8086	−6.0258	−3.5632
Twin-screw ship	−0.2748	0.5747	−6.7610	−4.3834

De aquí resulta:

$$C_R = 0.272$$

Con el valor de la $Bkw = 24510\ kW$ del buque de referencia se puede hallar el valor de “a” de la siguiente ecuación:

$$Rn = \frac{V*L}{\nu_{as}} = 2111201345; \nu_{as} = 1.19 * 10^{-6} m^2/s$$

$$Cfpp = \frac{0.075}{(log_{10}(Rn) - 2)^2} = 0.00139798$$

$$Bkw = a * (V^3 * \left(\frac{B * T}{10}\right) * (C_R + Cfpp)$$

Se obtiene entonces el valor de:

$$a = 1.567$$

Aplicando, con el valor de a obtenido, las ecuaciones anteriores, se puede obtener el valor de Bkw del buque a proyectar:

$$\boldsymbol{Bkw = 26013.94\ kW}$$

$$\boldsymbol{BHP = \frac{Bkw}{0.7547} = 34885.27\ CV}$$

- Segundo método. En este, para aproximar inicialmente la potencia propulsora del buque a tratar, se usa la formulación de Watson:

$$BHP = 0.889 * \frac{\Delta^{\frac{2}{3}} * (40 - \left(\frac{L}{61}\right) + 400 * (K-1)^2 - 12 * Cb}{15000 - 1.81 * N * \sqrt{L}} * V^3$$

En ella,

- V, es la velocidad en nudos; en el caso a tratar 15.5 nudos.
- $\Delta = Cb * L * B * T * 1.025 = 326020.70\ t$
- K es la constante de Alexander, obtenida como:

$$Cb = K - (0.5 * \left(\frac{V}{\sqrt{3.28 * L}}\right))$$

$$K = 1.09$$

- N, son las rpm del motor siguiendo el buque de referencia, en nuestro caso 66.4 rpm.

El resultado obtenido es:

$$\boldsymbol{BHP \approx 33827\ CV}$$

$$\boldsymbol{Bkw \approx 25225\ kW}$$

Se puede observar que los resultados obtenidos son prácticamente iguales, por lo que cualquiera de ellos sería válido para la continuación del desarrollo de este cuaderno. En el caso a tratar y para los cálculos que se desarrollarán en los siguientes apartados se usa el segundo de los métodos.

6.2.2 Aproximación de los pesos

Con el fin de obtener el peso de los aceros del buque proyectado, se usa la siguiente ecuación, sacada de los apuntes de la asignatura PBAM I:

$$\mathrm{PS} = \mathrm{K} * \mathrm{Lpp} * \mathrm{B} * \mathrm{D} * (Lpp/D)^{0.5}$$

Con K=0.038 para petroleros según el libro del profesor Fernando Junco O campo:

$$\mathbf{PS = 64365.72\ t}$$

- Es también necesario obtener una estimación inicial del Peso de la Maquinaria del buque en cuestión:

$$PQ(Peso\ de\ la\ maquinaria) = Bkw * (895 - 0.0025 * Bkw)/10000$$

$$\boldsymbol{PQ = 2098.54\ t}$$

- El peso del equipo restante viene dado por la siguiente fórmula:

$$\boldsymbol{PEr = 0.045 * L^{1.3} * B^{0.8} * D^{0.3} = 5502.67\ t}$$

Por tanto, el Peso en Rosca del buque a proyectar será el resultado de la suma de los tres valores obtenido con anterioridad:

$$\boldsymbol{PR = PS + PQ + PEr = 71966.94\ t}$$

6.2.3 Desglose de los costes

Primero, se deben evaluar los costes de forma empírica para obtener así el valor aproximado de los costes totales de la construcción del buque. Para ello la fórmula utilizada será la siguiente*:*

$$CC = (CMg + CEq + CMo + CVa)$$

A continuación, se desglosan cada una de las componentes de la ecuación anterior:

- Coeficiente de Coste de material a granel:

$$CMg = cmg * PS$$

$$cmg = ccs * cas * cem * ps$$

Para cmg, se coge un valor intermedio de coeficiente de ponderado de chapas y acero de distintas calidades de acero (ccs), de coeficiente de aprovechamiento de acero (cas), de incremento por equipo equipo metálico incluido en la estructura (Cem) y del precio unitario de acero para referencia (ps); detallados a continuación:

$$1{,}05 < ccs < 1{,}10 - 1{,}50$$
$$1{,}08 < cas < 1{,}15$$
$$1{,}03 < cem < 1{,}10$$

Entones se toman los siguientes valores:

$$ccs = 1.25$$

$$cas = 1.115$$

$$cem = 1.065$$

Tras la subida del acero naval en los últimos años, se considerará un valor de:

$$ps \approx 650€/t$$

Así se concluye que:

$$\boldsymbol{CMg = 64365.72}\ €$$

- El coste de los equipos del buque viene dado por:

$$CEq = CEp + CHf + CEr$$

Donde:

- CEp es el coste de los equipos de propulsión= cep*BHP
- cep es el precio unitario del KW= 380 €/kW
- CHf es el coste de habilitación y fonda= chf*nch*NT
- chf es el coste unitario de la habilitación por tripulante= 35000 €/tripulante
- nch es el coeficiente de calidad de habilitación= 1.05
- NT es el número de tripulantes, en el caso a proyectar 36.
- CEr es el coste de equipo restante= ccs*ps*Per

Con las cifras descritas con anterioridad se obtiene que:

$$\boldsymbol{CEq = 18826967.99}\ €$$

- El coste de Mano de Obra se corresponde con:

$$CMo = Cmm + CMe$$

- Cmm es el coste del montaje de los materiales a granel= chm*csh*PS
- chm es el coste horario medio del astillero= 36€/h
- csh es el coeficiente de horas por unidad de peso producidas= 40 h/t
- CMe es el costo de la mano de obra de montaje de los equipos e instalaciones, se tiene en cuenta porque no se conoce.

$$\boldsymbol{CMo = 92686643.8}\ €$$

- Debido a otros gastos no incluidos en las partidas anteriores como seguros, SSCC, gastos de representación, ensayos en canal, etc. Se debe añadir en este apartado, Costos Varios Aplicados (CVa):

$$CVa = cva * CC$$

Estos costos oscilan entre un 5 y 10 %, para los cálculos a realizar, se toma un 7.5%.

- Podemos concluir con un valor inicial del coste de construcción de:

$$\boldsymbol{CC = (CMg + CEq + CMo) * 1.075 = 187971493}\ €$$

6.3 Alternativas válidas

Para poder obtener las alternativas se ha usado como referencia el proceso que se describe en el Capítulo 5 del libro de “Criterios de Evaluación Técnica y Económica” del Dr. Fernando Junco Ocampo de Ingeniería Naval.

Las dimensiones preliminares obtenidas anteriormente mediante regresiones lineales son variadas ligeramente para conseguir una optimización de la cifra de mérito, en el caso a tratar, un menor coste de construcción.

Estas dimensiones se harán oscilar en ±10% a excepción del coeficiente de bloque que se varía en ±3% para la generación de las alternativas, de forma que no nos queden unas dimensiones excesivamente diferentes a las preliminares. Así las dimensiones deben estar comprendidas:

	MÁXIMO	**MÍNIMO**
L(m)	344.90	280.90
B(m)	64.50	51.50
D(m)	31.40	25.40
Cb	0.87	0.81

A continuación, se deben tener en cuenta las restricciones impuestas por nuestra RPA, en el caso a tratar es:

$$\boldsymbol{TPM = 275000\, TPM}$$

Otras restricciones serán los intervalos dentro de los cuales deben encontrarse las relaciones adimensionales siguientes,

	MÁXIMO	**MÍNIMO**
LBD	-	509975.71
L/B	9.11	5.32
T/D	0.75	0.63
B/D	2.1	1.83
L/D	10.06	11.74

Seguidamente, de las 21000 alternativas generadas, se representan aquellas que son válidas en cuanto a las relaciones descritas en la tabla anterior:

L	B	D	T	CB	CM	CP	Δ (t)	PS	PQ	PER	BkW (kW)	CC (M€)
308,9	56,5	29,40	20,7243229	0,87	0,99680611	0,87	322544,64	63202,2548	2212,10604	5396,58165	26708,9108	181,935517
308,9	56,5	29,40	20,9619478	0,86	0,99641982	0,86	322493,01	63202,2548	2160,48066	5396,58165	26032,4304	181,659175
308,9	56,5	29,40	21,2055148	0,85	0,9960125	0,85	322446,72	63202,2548	2114,19331	5396,58165	25428,4312	181,412441
308,9	56,5	29,40	21,4552406	0,84	0,99558273	0,84	322405,84	63202,2548	2073,30679	5396,58165	24896,8759	181,195301
308,9	56,5	29,40	21,7113512	0,83	0,99512899	0,83	322370,41	63202,2548	2037,87628	5396,58165	24437,7314	181,00774
308,9	**56,5**	**29,40**	**21,9740837**	**0,82**	**0,99464961**	**0,82**	**322340,48**	**63202,2548**	**2007,94943**	**5396,58165**	**24050,9688**	**180,849748**
308,9	56,5	30,40	20,796609	0,87	0,99680611	0,87	323669,67	64268,1352	2216,83149	5451,0056	26770,9816	184,787919
308,9	56,5	30,40	21,0350679	0,86	0,99641982	0,86	323617,94	64268,1352	2165,10724	5451,0056	26092,9334	184,510936
308,9	56,5	30,40	21,2794894	0,85	0,9960125	0,85	323571,57	64268,1352	2118,73071	5451,0056	25487,5342	184,263631
308,9	56,5	30,40	21,5300905	0,84	0,99558273	0,84	323530,60	64268,1352	2077,76498	5451,0056	24954,7467	184,045987
308,9	56,5	30,40	21,7870983	0,83	0,99512899	0,83	323495,10	64268,1352	2042,26553	5451,0056	24494,5377	183,857992
308,9	56,5	30,40	22,0507505	0,82	0,99464961	0,82	323465,11	64268,1352	2012,28021	5451,0056	24106,8783	183,699633
308,9	56,5	30,40	22,321296	0,81	0,99414282	0,81	323440,68	64268,1352	1987,84931	5451,0056	23791,7439	183,5709
308,9	57,5	29,40	20,4396583	0,87	0,99680611	0,87	323744,58	64320,8787	2217,14587	5472,85913	26775,1121	184,946903
308,9	57,5	29,40	20,6740248	0,86	0,99641982	0,86	323692,85	64320,8787	2165,41505	5472,85913	26096,9595	184,669878
308,9	57,5	29,40	20,9142513	0,85	0,9960125	0,85	323646,46	64320,8787	2119,03259	5472,85913	25491,4672	184,422534
308,9	57,5	29,40	21,1605514	0,84	0,99558273	0,84	323605,49	64320,8787	2078,0616	5472,85913	24958,5977	184,204857
308,9	57,5	29,40	21,4131482	0,83	0,99512899	0,83	323569,99	64320,8787	2042,55756	5472,85913	24498,3179	184,016833
308,9	57,5	29,40	21,6722754	0,82	0,99464961	0,82	323540,00	64320,8787	2012,56835	5472,85913	24110,5988	183,85845
308,9	57,5	29,40	21,9381774	0,81	0,99414282	0,81	323515,57	64320,8787	1988,13427	5472,85913	23795,4159	183,729697
308,9	57,5	30,40	20,5119316	0,87	0,99680611	0,87	324889,32	65405,6243	2221,94602	5528,05233	26838,1916	187,849577
308,9	57,5	30,40	20,747132	0,86	0,99641982	0,86	324837,49	65405,6243	2170,11483	5528,05233	26158,4458	187,571901
308,9	57,5	30,40	20,9882128	0,85	0,9960125	0,85	324791,01	65405,6243	2123,64182	5528,05233	25551,5308	187,323976
308,9	57,5	30,40	21,2353881	0,84	0,99558273	0,84	324749,96	65405,6243	2082,59042	5528,05233	25017,409	187,105788
308,9	57,5	30,40	21,488882	0,83	0,99512899	0,83	324714,39	65405,6243	2047,01638	5528,05233	24556,0474	186,917321
308,9	57,5	30,40	21,7489287	0,82	0,99464961	0,82	324684,34	65405,6243	2016,96781	5528,05233	24167,417	186,758566

308,9	57,5	30,40	22,0157738	0,81	0,99414282	0,81	324659,86	65405,6243	1992,48521	5528,05233	23851,4932	186,629511
310,9	56,5	29,40	20,6329458	0,87	0,99680611	0,87	323201,62	63817,06	2208,81512	5442,04852	26665,6981	183,561304
310,9	56,5	29,40	20,8695506	0,86	0,99641982	0,86	323150,32	63817,06	2157,5132	5442,04852	25993,6367	183,286767
310,9	56,5	29,40	21,1120724	0,85	0,9960125	0,85	323104,37	63817,06	2111,56382	5442,04852	25394,1905	183,041894
310,9	56,5	29,40	21,3607265	0,84	0,99558273	0,84	323063,83	63817,06	2071,02941	5442,04852	24867,3223	182,826668
310,9	56,5	29,40	21,6157382	0,83	0,99512899	0,83	323028,77	63817,06	2035,9648	5442,04852	24412,9993	182,641077
310,9	56,5	29,40	21,8773435	0,82	0,99464961	0,82	322999,22	63817,06	2006,4172	5442,04852	24031,1928	182,485109
310,9	56,5	30,40	20,7054599	0,87	0,99680611	0,87	324337,50	64893,3089	2213,57009	5496,931	26728,139	186,441293
310,9	56,5	30,40	20,9429015	0,86	0,99641982	0,86	324286,10	64893,3089	2162,16914	5496,931	26054,5083	186,166115
310,9	56,5	30,40	21,1862804	0,85	0,9960125	0,85	324240,06	64893,3089	2116,13052	5496,931	25453,662	185,92067
310,9	56,5	30,40	21,4358127	0,84	0,99558273	0,84	324199,45	64893,3089	2075,51698	5496,931	24925,5632	185,704941
310,9	56,5	30,40	21,6917245	0,83	0,99512899	0,83	324164,32	64893,3089	2040,38359	5496,931	24470,1788	185,518917
310,9	56,5	30,40	21,9542525	0,82	0,99464961	0,82	324134,71	64893,3089	2010,77782	5496,931	24087,4804	185,362584
310,9	56,5	30,40	22,2236444	0,81	0,99414282	0,81	324110,67	64893,3089	1986,73949	5496,931	23777,4436	185,235934
310,9	57,5	29,40	20,350108	0,87	0,99680611	0,87	324413,11	64946,5655	2213,88634	5518,96865	26732,2928	186,601792
310,9	57,5	29,40	20,5834749	0,86	0,99641982	0,86	324361,71	64946,5655	2162,4788	5518,96865	26058,5577	186,326571
310,9	57,5	29,40	20,8226771	0,85	0,9960125	0,85	324315,66	64946,5655	2116,43425	5518,96865	25457,6183	186,081087
310,9	57,5	29,40	21,0679272	0,84	0,99558273	0,84	324275,04	64946,5655	2075,81545	5518,96865	24929,4376	185,865325
310,9	57,5	29,40	21,3194472	0,83	0,99512899	0,83	324239,91	64946,5655	2040,67749	5518,96865	24473,9826	185,679272
310,9	57,5	29,40	21,5774698	0,82	0,99464961	0,82	324210,30	64946,5655	2011,06784	5518,96865	24091,2248	185,522915
310,9	57,5	29,40	21,8422385	0,81	0,99414282	0,81	324186,25	64946,5655	1987,02637	5518,96865	23781,1399	185,396246
310,9	57,5	30,40	20,4226092	0,87	0,99680611	0,87	325568,90	66041,863	2218,71641	5574,62686	26795,7479	189,532539
310,9	57,5	30,40	20,6568128	0,86	0,99641982	0,86	325517,39	66041,863	2167,20834	5574,62686	26120,4179	189,256667
310,9	57,5	30,40	20,896872	0,85	0,9960125	0,85	325471,26	66041,863	2121,0732	5574,62686	25518,0558	189,010602
310,9	57,5	30,40	21,1430001	0,84	0,99558273	0,84	325430,56	66041,863	2080,37405	5574,62686	24988,6244	188,794329
310,9	57,5	30,40	21,3954201	0,83	0,99512899	0,83	325395,35	66041,863	2045,16627	5574,62686	24532,091	188,607835
310,9	57,5	30,40	21,6543653	0,82	0,99464961	0,82	325365,68	66041,863	2015,49756	5574,62686	24148,4267	188,451108

310,9	57,5	30,40	21,9200801	0,81	0,99414282	0,81	325341,59	66041,863	1991,40798	5574,62686	23837,6074	188,324139
312,9	55,5	29,40	20,8340155	0,87	0,99680611	0,87	322637,35	63293,4239	2200,47192	5409,76415	26556,1995	182,122689
312,9	55,5	29,40	21,0729481	0,86	0,99641982	0,86	322586,48	63293,4239	2149,59721	5409,76415	25890,199	181,850628
312,9	55,5	29,40	21,3178567	0,85	0,9960125	0,85	322540,96	63293,4239	2104,0789	5409,76415	25296,7652	181,608211
312,9	55,5	29,40	21,5689588	0,84	0,99558273	0,84	322500,86	63293,4239	2063,97876	5409,76415	24775,8613	181,395421
312,9	55,5	29,40	21,8264819	0,83	0,99512899	0,83	322466,23	63293,4239	2029,35094	5409,76415	24327,4548	181,212247
312,9	56,5	29,40	20,5428719	0,87	0,99680611	0,87	323860,73	64433,8459	2205,58437	5487,60323	26623,2875	185,192661
312,9	56,5	29,40	20,7784711	0,86	0,99641982	0,86	323809,75	64433,8459	2154,60361	5487,60323	25955,6091	184,919914
312,9	56,5	29,40	21,0199623	0,85	0,9960125	0,85	323764,13	64433,8459	2108,98985	5487,60323	25360,6801	184,676886
312,9	56,5	29,40	21,26756	0,84	0,99558273	0,84	323723,95	64433,8459	2068,80517	5487,60323	24838,4636	184,46356
312,9	56,5	29,40	21,5214884	0,83	0,99512899	0,83	323689,25	64433,8459	2034,10403	5487,60323	24388,927	184,279924
312,9	56,5	29,40	21,7819824	0,82	0,99464961	0,82	323660,08	64433,8459	2004,93322	5487,60323	24012,042	184,125967
312,9	56,5	29,40	22,0492878	0,81	0,99414282	0,81	323636,47	64433,8459	1981,33196	5487,60323	23707,7846	184,001678
312,9	56,5	30,40	20,6156133	0,87	0,99680611	0,87	325007,50	65520,4967	2210,36885	5542,94513	26686,0984	188,100325
312,9	56,5	30,40	20,852052	0,86	0,99641982	0,86	324956,42	65520,4967	2159,28889	5542,94513	26016,8492	187,826936
312,9	56,5	30,40	21,0944031	0,85	0,9960125	0,85	324910,72	65520,4967	2113,58585	5542,94513	25420,5202	187,583336
312,9	56,5	30,40	21,3428817	0,84	0,99558273	0,84	324870,46	65520,4967	2073,32211	5542,94513	24897,0748	187,369509
312,9	56,5	30,40	21,5977131	0,83	0,99512899	0,83	324835,69	65520,4967	2038,55237	5542,94513	24446,4801	187,185441
312,9	56,5	30,40	21,8591328	0,82	0,99464961	0,82	324806,46	65520,4967	2009,32369	5542,94513	24068,7079	187,031121
312,9	56,5	30,40	22,1273875	0,81	0,99414282	0,81	324782,81	65520,4967	1985,67546	5542,94513	23763,7343	186,906539
312,9	57,5	28,40	20,187836	0,87	0,99680611	0,87	323896,53	64449,4115	2205,73386	5507,69045	26625,2496	185,252272
312,9	57,5	28,40	20,4193637	0,86	0,99641982	0,86	323845,55	64449,4115	2154,74999	5507,69045	25957,5221	184,979505
312,9	57,5	28,40	20,6566814	0,85	0,9960125	0,85	323799,93	64449,4115	2109,13344	5507,69045	25362,5494	184,736459
312,9	57,5	28,40	20,9	0,84	0,99558273	0,84	323759,74	64449,4115	2068,9463	5507,69045	24840,2945	184,523118
312,9	57,5	28,40	21,14954	0,83	0,99512899	0,83	323725,04	64449,4115	2034,24301	5507,69045	24390,7248	184,339468
312,9	57,5	29,40	20,2618373	0,87	0,99680611	0,87	325083,82	65574,268	2210,68696	5565,16725	26690,2755	188,262341
312,9	57,5	29,40	20,4942189	0,86	0,99641982	0,86	325032,73	65574,268	2159,60041	5565,16725	26020,9218	187,98891

312,9	57,5	29,40	20,7324114	0,85	0,9960125	0,85	324987,02	65574,268	2113,89143	5565,16725	25424,4998	187,745272
312,9	57,5	29,40	20,9766263	0,84	0,99558273	0,84	324946,75	65574,268	2073,62243	5565,16725	24900,9726	187,531411
312,9	57,5	29,40	21,2270848	0,83	0,99512899	0,83	324911,98	65574,268	2038,84814	5565,16725	24450,3075	187,347314
312,9	57,5	29,40	21,4840186	0,82	0,99464961	0,82	324882,74	65574,268	2009,61561	5565,16725	24072,4764	187,19297
312,9	57,5	29,40	21,7476701	0,81	0,99414282	0,81	324859,09	65574,268	1985,96425	5565,16725	23767,4551	187,068369
312,9	57,5	30,40	20,3345659	0,87	0,99680611	0,87	326250,68	66680,1515	2215,54694	5621,29137	26754,106	191,221252
312,9	57,5	30,40	20,5677868	0,86	0,99641982	0,86	326199,50	66680,1515	2164,3597	5621,29137	26083,156	190,947169
312,9	57,5	30,40	20,806839	0,85	0,9960125	0,85	326153,70	66680,1515	2118,56009	5621,29137	25485,3113	190,702949
312,9	57,5	30,40	21,0519347	0,84	0,99558273	0,84	326113,35	66680,1515	2078,21082	5621,29137	24960,5352	190,488578
312,9	57,5	30,40	21,3032961	0,83	0,99512899	0,83	326078,50	66680,1515	2043,36689	5621,29137	24508,7949	190,304042
312,9	57,5	30,40	21,5611554	0,82	0,99464961	0,82	326049,21	66680,1515	2014,0756	5621,29137	24130,0623	190,14933
312,9	57,5	30,40	21,825756	0,81	0,99414282	0,81	326025,51	66680,1515	1990,37655	5621,29137	23824,3132	190,024431
312,9	58,5	28,40	19,9164053	0,87	0,99680611	0,87	325098,90	65570,2708	2210,74984	5584,18684	26691,1012	188,269539
312,9	58,5	28,40	20,1448252	0,86	0,99641982	0,86	325047,81	65570,2708	2159,66199	5584,18684	26021,7268	187,9961
312,9	58,5	28,40	20,3789569	0,85	0,9960125	0,85	325002,10	65570,2708	2113,95184	5584,18684	25425,2864	187,752454
312,9	58,5	28,40	20,6190084	0,84	0,99558273	0,84	324961,83	65570,2708	2073,6818	5584,18684	24901,743	187,538586
312,9	58,5	28,40	20,8651971	0,83	0,99512899	0,83	324927,06	65570,2708	2038,9066	5584,18684	24451,0641	187,354484
312,9	58,5	28,40	21,1177506	0,82	0,99464961	0,82	324897,82	65570,2708	2009,67331	5584,18684	24073,2213	187,200135
312,9	58,5	29,40	19,9903936	0,87	0,99680611	0,87	326306,63	66714,69	2215,77974	5642,46193	26757,1643	191,331737
312,9	58,5	29,40	20,2196674	0,86	0,99641982	0,86	326255,43	66714,69	2164,58768	5642,46193	26086,1377	191,057622
312,9	58,5	29,40	20,4546737	0,85	0,9960125	0,85	326209,63	66714,69	2118,78373	5642,46193	25488,2249	190,813375
312,9	58,5	29,40	20,6956213	0,84	0,99558273	0,84	326169,28	66714,69	2078,43061	5642,46193	24963,3889	190,59898
312,9	58,5	29,40	20,9427284	0,83	0,99512899	0,83	326134,43	66714,69	2043,58335	5642,46193	24511,5972	190,414423
312,9	58,5	29,40	21,1962235	0,82	0,99464961	0,82	326105,14	66714,69	2014,28924	5642,46193	24132,8213	190,259693
312,9	58,5	29,40	21,4563457	0,81	0,99414282	0,81	326081,43	66714,69	1990,58792	5642,46193	23827,0373	190,13478
312,9	58,5	30,40	20,0631095	0,87	0,99680611	0,87	327493,58	67839,8063	2220,71499	5699,36556	26822,0119	194,34189
312,9	58,5	30,40	20,2932226	0,86	0,99641982	0,86	327442,29	67839,8063	2169,42074	5699,36556	26149,3636	194,067113

312,9	58,5	30,40	20,5290885	0,85	0,9960125	0,85	327396,39	67839,8063	2123,52479	5699,36556	25550,0055	193,822275
312,9	58,5	30,40	20,7709168	0,84	0,99558273	0,84	327355,96	67839,8063	2083,09021	5699,36556	25023,9007	193,607361
312,9	58,5	30,40	21,0189266	0,83	0,99512899	0,83	327321,04	67839,8063	2048,17227	5699,36556	24571,0166	193,422358
312,9	58,5	30,40	21,273347	0,82	0,99464961	0,82	327291,68	67839,8063	2018,81852	5699,36556	24191,3248	193,267254
312,9	58,5	30,40	21,5344182	0,81	0,99414282	0,81	327267,93	67839,8063	1995,06879	5699,36556	23884,8014	193,142039
314,9	55,5	29,40	20,7433749	0,87	0,99680611	0,87	323286,95	63901,2327	2197,26857	5454,75888	26514,1787	183,730302
314,9	55,5	29,40	20,9812954	0,86	0,99641982	0,86	323236,40	63901,2327	2146,71291	5454,75888	25852,5274	183,460018
314,9	55,5	29,40	21,2251667	0,85	0,9960125	0,85	323191,21	63901,2327	2101,52795	5454,75888	25263,5756	183,219431
314,9	55,5	29,40	21,4752055	0,84	0,99558273	0,84	323151,46	63901,2327	2061,77512	5454,75888	24747,2868	183,008527
314,9	55,5	29,40	21,7316382	0,83	0,99512899	0,83	323117,19	63901,2327	2027,50817	5454,75888	24303,6287	182,827293
314,9	55,5	29,40	21,994702	0,82	0,99464961	0,82	323088,46	63901,2327	1998,77328	5454,75888	23932,5732	182,675717
314,9	56,5	29,40	20,4540758	0,87	0,99680611	0,87	324521,96	65052,6062	2202,41249	5533,24538	26581,6611	186,829562
314,9	56,5	29,40	20,6886836	0,86	0,99641982	0,86	324471,30	65052,6062	2151,75061	5533,24538	25918,3305	186,558591
314,9	56,5	29,40	20,9291588	0,85	0,9960125	0,85	324426,02	65052,6062	2106,47016	5533,24538	25327,8836	186,317394
314,9	56,5	29,40	21,1757149	0,84	0,99558273	0,84	324386,18	65052,6062	2066,63288	5533,24538	24810,2841	186,105954
314,9	56,5	29,40	21,4285753	0,83	0,99512899	0,83	324351,84	65052,6062	2032,29281	5533,24538	24365,4994	185,92426
314,9	56,5	29,40	21,6879737	0,82	0,99464961	0,82	324323,04	65052,6062	2003,49637	5533,24538	23993,5017	185,772299
314,9	56,5	29,40	21,954155	0,81	0,99414282	0,81	324299,83	65052,6062	1980,28234	5533,24538	23694,2672	185,650061
314,9	56,5	30,40	20,5270438	0,87	0,99680611	0,87	325679,66	66149,6921	2207,22646	5589,04757	26644,842	189,764988
314,9	56,5	30,40	20,7624938	0,86	0,99641982	0,86	325628,90	66149,6921	2156,46524	5589,04757	25979,939	189,493376
314,9	56,5	30,40	21,0038315	0,85	0,9960125	0,85	325583,53	66149,6921	2111,09547	5589,04757	25388,0925	189,251606
314,9	56,5	30,40	21,2512715	0,84	0,99558273	0,84	325543,61	66149,6921	2071,17919	5589,04757	24869,2657	189,039665
314,9	56,5	30,40	21,5050376	0,83	0,99512899	0,83	325509,20	66149,6921	2036,77072	5589,04757	24423,4264	188,85754
314,9	56,5	30,40	21,7653647	0,82	0,99464961	0,82	325480,35	66149,6921	2007,91671	5589,04757	24050,5465	188,705219
314,9	56,5	30,40	22,0324982	0,81	0,99414282	0,81	325457,09	66149,6921	1984,65613	5589,04757	23750,6023	188,582691
314,9	57,5	28,40	20,1005897	0,87	0,99680611	0,87	324558,08	65068,3213	2202,5628	5553,49967	26583,6335	186,889718
314,9	57,5	28,40	20,3311432	0,86	0,99641982	0,86	324507,41	65068,3213	2151,89782	5553,49967	25920,2537	186,618728

314,9	57,5	28,40	20,5674627	0,85	0,9960125	0,85	324462,13	65068,3213	2106,61458	5553,49967	25329,7632	186,377512
314,9	57,5	28,40	20,8097579	0,84	0,99558273	0,84	324422,29	65068,3213	2066,77483	5553,49967	24812,1253	186,166057
314,9	57,5	28,40	21,0582485	0,83	0,99512899	0,83	324387,95	65068,3213	2032,43262	5553,49967	24367,3078	185,984349
314,9	57,5	29,40	20,1748214	0,87	0,99680611	0,87	325756,67	66203,9798	2207,54643	5611,45452	26649,0424	189,928528
314,9	57,5	29,40	20,4062317	0,86	0,99641982	0,86	325705,91	66203,9798	2156,7786	5611,45452	25984,0349	189,656872
314,9	57,5	29,40	20,6434286	0,85	0,9960125	0,85	325660,53	66203,9798	2111,4029	5611,45452	25392,0952	189,415065
314,9	57,5	29,40	20,886623	0,84	0,99558273	0,84	325620,61	66203,9798	2071,48137	5611,45452	24873,1869	189,203091
314,9	57,5	29,40	21,1360351	0,83	0,99512899	0,83	325586,20	66203,9798	2037,06836	5611,45452	24427,2774	189,020937
314,9	57,5	29,40	21,3918954	0,82	0,99464961	0,82	325557,34	66203,9798	2008,21053	5611,45452	24054,3389	188,868592
314,9	57,5	29,40	21,6544454	0,81	0,99414282	0,81	325534,07	66203,9798	1984,94685	5611,45452	23754,3476	188,746045
314,9	57,5	30,40	20,2477766	0,87	0,99680611	0,87	326934,66	67320,4831	2212,43631	5668,04544	26713,2483	192,91569
314,9	57,5	30,40	20,4800288	0,86	0,99641982	0,86	326883,79	67320,4831	2161,56764	5668,04544	26046,643	192,643382
314,9	57,5	30,40	20,7180882	0,85	0,9960125	0,85	326838,32	67320,4831	2116,10126	5668,04544	25453,2809	192,400994
314,9	57,5	30,40	20,9621663	0,84	0,99558273	0,84	326798,32	67320,4831	2076,09954	5668,04544	24933,1254	192,18851
314,9	57,5	30,40	21,212484	0,83	0,99512899	0,83	326763,84	67320,4831	2041,61709	5668,04544	24486,1442	192,005918
314,9	57,5	30,40	21,4692728	0,82	0,99464961	0,82	326734,92	67320,4831	2012,70081	5668,04544	24112,3092	191,853207
314,9	57,5	30,40	21,7327749	0,81	0,99414282	0,81	326711,61	67320,4831	1989,38987	5668,04544	23811,5966	191,730365
314,9	58,5	28,40	19,8308783	0,87	0,99680611	0,87	325771,88	66199,9442	2207,6096	5630,6323	26649,8716	189,935771
314,9	58,5	28,40	20,0583435	0,86	0,99641982	0,86	325721,11	66199,9442	2156,84047	5630,6323	25984,8435	189,664107
314,9	58,5	28,40	20,2914967	0,85	0,9960125	0,85	325675,73	66199,9442	2111,46359	5630,6323	25392,8855	189,422292
314,9	58,5	28,40	20,5305452	0,84	0,99558273	0,84	325635,81	66199,9442	2071,54103	5630,6323	24873,961	189,210312
314,9	58,5	28,40	20,7757053	0,83	0,99512899	0,83	325601,40	66199,9442	2037,12712	5630,6323	24428,0378	189,028152
314,9	58,5	28,40	21,0272037	0,82	0,99464961	0,82	325572,54	66199,9442	2008,26853	5630,6323	24055,0876	188,875802
314,9	58,5	28,40	21,2852777	0,81	0,99414282	0,81	325549,27	66199,9442	1985,00424	5630,6323	23755,087	188,753251
314,9	58,5	29,40	19,9050971	0,87	0,99680611	0,87	326991,11	67355,3534	2212,67045	5689,39209	26716,3232	193,027206
314,9	58,5	29,40	20,1334189	0,86	0,99641982	0,86	326940,24	67355,3534	2161,79695	5689,39209	26049,6414	192,754867
314,9	58,5	29,40	20,3674495	0,85	0,9960125	0,85	326894,77	67355,3534	2116,32623	5689,39209	25456,2112	192,512451

314,9	58,5	29,40	20,6073969	0,84	0,99558273	0,84	326854,76	67355,3534	2076,32066	5689,39209	24935,996	192,299943
314,9	58,5	29,40	20,8534784	0,83	0,99512899	0,83	326820,27	67355,3534	2041,83489	5689,39209	24488,9634	192,11733
314,9	58,5	29,40	21,1059213	0,82	0,99464961	0,82	326791,36	67355,3534	2012,91581	5689,39209	24115,0854	191,964601
314,9	58,5	29,40	21,364964	0,81	0,99414282	0,81	326768,04	67355,3534	1989,60261	5689,39209	23814,3384	191,841746
314,9	58,5	30,40	19,9780396	0,87	0,99680611	0,87	328189,37	68491,2741	2217,63599	5746,769	26781,5516	196,066101
314,9	58,5	30,40	20,2072032	0,86	0,99641982	0,86	328138,40	68491,2741	2166,66015	5746,769	26113,2465	195,793098
314,9	58,5	30,40	20,4420962	0,85	0,9960125	0,85	328092,83	68491,2741	2121,09741	5746,769	25518,3712	195,550092
314,9	58,5	30,40	20,6829271	0,84	0,99558273	0,84	328052,75	68491,2741	2081,01045	5746,769	24996,889	195,337066
314,9	58,5	30,40	20,9299141	0,83	0,99512899	0,83	328018,19	68491,2741	2046,45421	5746,769	24548,7676	195,154008
314,9	58,5	30,40	21,1832853	0,82	0,99464961	0,82	327989,21	68491,2741	2017,4758	5746,769	24173,9789	195,000907
314,9	58,5	30,40	21,44328	0,81	0,99414282	0,81	327965,85	68491,2741	1994,11463	5746,769	23872,4992	194,877753
316,9	55,5	29,40	20,6540109	0,87	0,99680611	0,87	323938,63	64510,9747	2194,12285	5499,83943	26472,925	185,343345
316,9	55,5	29,40	20,8909334	0,86	0,99641982	0,86	323888,39	64510,9747	2143,88399	5499,83943	25815,5881	185,074823
316,9	55,5	29,40	21,1337819	0,85	0,9960125	0,85	323843,54	64510,9747	2099,0301	5499,83943	25231,0838	184,836053
316,9	55,5	29,40	21,3827722	0,84	0,99558273	0,84	323804,13	64510,9747	2059,62225	5499,83943	24719,3759	184,62702
316,9	55,5	29,40	21,6381299	0,83	0,99512899	0,83	323770,22	64510,9747	2025,71383	5499,83943	24280,4322	184,447711
316,9	55,5	29,40	21,9000908	0,82	0,99464961	0,82	323741,86	64510,9747	1997,3506	5499,83943	23914,225	184,298116
316,9	56,5	29,40	20,3665328	0,87	0,99680611	0,87	325185,30	65673,3346	2199,29822	5578,97457	26540,8018	188,471984
316,9	56,5	29,40	20,6001632	0,86	0,99641982	0,86	325134,96	65673,3346	2148,95299	5578,97457	25881,7841	188,202775
316,9	56,5	29,40	20,8396366	0,85	0,9960125	0,85	325090,01	65673,3346	2104,00358	5578,97457	25295,7851	187,963395
316,9	56,5	29,40	21,0851657	0,84	0,99558273	0,84	325050,51	65673,3346	2064,51136	5578,97457	24782,7683	187,753827
316,9	56,5	29,40	21,336973	0,83	0,99512899	0,83	325016,53	65673,3346	2030,53003	5578,97457	24342,7018	187,57406
316,9	56,5	29,40	21,5952912	0,82	0,99464961	0,82	324988,11	65673,3346	2002,10558	5578,97457	23975,5578	187,424082
316,9	56,5	29,40	21,8603641	0,81	0,99414282	0,81	324965,28	65673,3346	1979,27637	5578,97457	23681,313	187,303883
316,9	56,5	30,40	20,4397267	0,87	0,99680611	0,87	326353,96	66780,8888	2204,14166	5635,23794	26604,3525	191,43526
316,9	56,5	30,40	20,6742018	0,86	0,99641982	0,86	326303,52	66780,8888	2153,69694	5635,23794	25943,7612	191,165409
316,9	56,5	30,40	20,9145406	0,85	0,9960125	0,85	326258,48	66780,8888	2108,65817	5635,23794	25356,3626	190,925456

De todas las alternativas válidas se debe coger aquella cuyo coste de construcción sea el menor:

L (m)	B (m)	D (m)	T (m)	CB	Δ (t)	PS (t)	PQ (t)	PER (t)	BkW (kW)	CC (M€)
308.9	56.5	29.4	21.97	0.82	322340.48	63202.25	2007.95	5396.58	24050.97	180.85

Con la alternativa escogida tras las estimaciones anteriores, es muy importante remarcar que se produce un ahorro de **3.42 M€** respecto a la alternativa inicial; por lo que el buque a proyectar presenta una viabilidad económica mayor.

7 COMPROBACIÓN DEL FRANCOBORDO

La estimación de una aproximación del francobordo resultará útil para la obtención de un dimensionamiento preliminar posterior. Para ello, se utiliza el Convenio Internacional de Líneas de Carga de 1966 y así se obtendrán las reglas que debemos aplicar.

Las características principales del buque óptimo son:

- Lpp= 308.9 m
- B= 56.9 m
- D= 29.40 m
- Cb= 0.82

El buque a diseñar dispone de una superestructura en popa que será considerada caseta, con lo cual no se incluye en el cálculo de francobordo.

Tipo de buque: A

7.1 Francobordo tabular

Suponiendo que la eslora entre perpendiculares es igual a la eslora de francobordo, podemos obtener el francobordo tabular mediante la tabla de francobordo para busques de tipo “A” del Convenio Internacional de Líneas de Carga de 1966.

Así, a 308.9 m de eslora le corresponden 3294.7 mm de francobordo.

- Corrección por eslora menor de 100 m

  No se realiza ya que $L > 100\ m$.

- Correción por Cb (R-30)

  Como el Cb es superior a 0.68, el FB tabular se multiplica por:

  $$\frac{Cb + 0.68}{1.36} = 1.1029$$

  La corrección ser aplicada será entonces,

  $$Reducción = 1.1029 * FB\ tubular = 3633.86$$

  Esto nos da un aumento de,

  $$339.02\ mm \approx 340\ mm$$

- Corrección por puntal (R-31)

  Se debe comprobar si L/15 excede o no el valor de D,

  $$\frac{L}{15} = 20.59\ m < D(29.40\ m)$$

Entonces se aplica,

$$Reducción = \left(D - \frac{L}{15}\right) * R = 2201.67\ mm$$

R=250 ya que el buque a tratar tiene una eslora superior a 120 m.

- Corrección por superestructuras (Regla 37)

$$Reducción = De * porcentaje$$

  - De=1070 mm por ser la eslora del buque a proyectar superior a 122 m.

Como ya se ha mencionado con anterioridad, la superestructura de popa no es lo suficientemente extensa como para ser considera para esta corrección, siendo la única superestructura válida el castillo de proa.

Este consta de 20 m de eslora y 1 m de longitud, además, ocupa toda la manga del buque.

Se entra en la tabla 37.1 del Convenio de Líneas de carga para obtener el porcentaje de reducción que será aplicado sobre el valor de 1070 mm.

R37 Table 37.1	
E	%
0	0
0,0647	*-4,529*
0,3	21

La reducción aplicada es de 4.529%, por lo que obtenemos

$$Reducción = 1070 * 0.04529 = 48.5\ mm$$

- Corrección por arrufo (R-38)

El buque a tratar no presenta arrufo ni en popa ni en proa, salvo por el castillo de proa. Tras la comparación con el arrufo estándar, por medio de la tabla EXCEL facilitada por el profesor de la asignatura de PBAM I, se obtiene una corrección de 1024 mm.

7.2 Francobordo total

Una vez realizadas todas las correcciones, se puede obtener el francobordo total:

$$FB = (1.1029 * 3294.7) + 2201.67 - 48.5 + 1024 = 6810.9\ mm$$

$$FB_{\min VERANO} = 6810.9\ mm$$

$$T_{VERANO} = D * 1000 + 0.02 - 6810.9 = 22589.12\ mm \approx 22.6\ m$$

El valor de calado obtenido indica que se tienen unos 0.6 m de reserva de flotabilidad, ya que el buque a tratar no calará más de 22 m.

$$Cflotación = \frac{1 + 2 * Cb}{3} = 0.89$$

$$Francobordo\ tropical = FB_{verano} - \frac{T_{VERANO}}{48} = 6340.30\ mm$$

$$Francobordo\ invierno = FB_{verano} + \frac{T_{VERANO}}{48} = 7281.50\ mm$$

$$Francobordo\ agua\ dulce = FB_{min\ Verano} - \frac{\Delta}{40 * T} = 6760.23\ mm$$

Siendo,

- T: toneladas por cm de inmersión en agua salada, en la flotación en carga de verano= Área de flotación*1.026*0.01cm= 15501.30*1.026*0.01=159.04 t-cm de inmersión

Se adjunta como “Anexo: Francobordo” la tabla EXCEL como comprobación de los cálculos.

En la anterior tabla podemos ver que el francobordo tropical tiene un valor superior a los cálculos realizados a mano, esto se debe a que en la tabla es escogido como francobordo tropical al número máximo entre el francobordo por escantil y el valor obtenido por medio de la formulación; en el caso a tratar es de valor superior el francobordo por escantil.

8 ESTIMACIÓN DE LA POTENCIA PROPULSORA

Para la estimación de la potencia propulsora es empleado en software NAVCAD, usado anteriormente en la asignatura de hidrodinámica naval y, actualmente, en PBAM I. Este programa, al introducir los datos del buque a tratar y mediante sus propias bases de datos, se recada la información suficiente para hacer una estimación de resistencia al avance que ofrece el buque a proyectar y la potencia propulsora necesaria para cumplir la velocidad fijada en la RPA.

Lo primero es decir si el buque diseñado es de desplazamiento o de planeo, el tratado es de desplazamiento por lo que se escoge para la estimación, la ITTC-78 (su velocidad no es tan elevada respecto al desplazamiento). Además, el buque es monocasco, presenta un codillo redondeado, sin bulbo y una única hélice.

Los datos y dimensiones del buque planteado son introducidos en NAVCAD:

Hull data

General		
Configuration:		**Monohull**
Chine type:		**Round/multiple**
Length on WL:		**308,900 m**
Max beam on WL:	[LWL/BWL 5,467]	**56,500 m**
Max molded draft:	[BWL/T 2,572]	**21,970 m**
Displacement:	[CB 0,819]	**322340,48 t**
Wetted surface:	[CS 2,682]	**26421,900 m2**
ITTC-78 (CT)		
LCB fwd TR:	[XCB/LWL 0,518]	**160,100 m**
LCF fwd TR:	[XCF/LWL 0,512]	**158,276 m**
Max section area:	[CX 0,995]	**1235,100 m2**
Waterplane area:	[CWP 0,888]	**15501,300 m2**
Bulb section area:		**0,000 m2**
Bulb ctr below WL:		**0,000 m**
Bulb nose fwd TR:		**0,000 m**
Imm transom area:	[ATR/AX 0,036]	**44,194 m2**
Transom beam WL:	[BTR/BWL 0,000]	**0,000 m**
Transom immersion:	[TTR/T 0,000]	**0,000 m**
Half entrance angle:		**49,52 deg**
Bow shape factor:	[AVG flow]	**0,0**
Stern shape factor:	[WL flow]	**1,0**

Se supone que las pruebas de mar se realizan sin viento pero sí se presenta una resistencia aerodinámica dada por:

Environment data

Wind		**Seas**	
Wind speed:	**0,00 kt**	Significant wave ht:	**0,000 m**
Angle off bow:	**0,00 deg**	Modal wave period:	**0,0 sec**
Gradient correction:	**Off**	**Shallow/channel**	
Exposed hull		Water depth:	**0,000 m**
Transverse area:	**1276,900 m2**	Type:	**Shallow water**
VCE above WL:	**26,470 m**	Channel width:	**0,000 m**
Profile area:	**4293,864 m2**	Channel side slope:	**0,00 deg**
Superstructure		Hull girth:	**0,000 m**
Superstructure shape:	**Tanker/Bulker**		
Transverse area:	**861,908 m2**		
VCE above WL:	**46,000 m**		
Profile area:	**4293,864 m2**		

Una vez se han introducido toda la información requerida por el programa, se calculan los valores restantes mediante las estimaciones posibles en NAVCAD, en el caso a tratar, se usa mayoritariamente la serie sistemática de holtrop, ya que los valores del buque diseñado se ajustan a sus requisitos perfectamente:

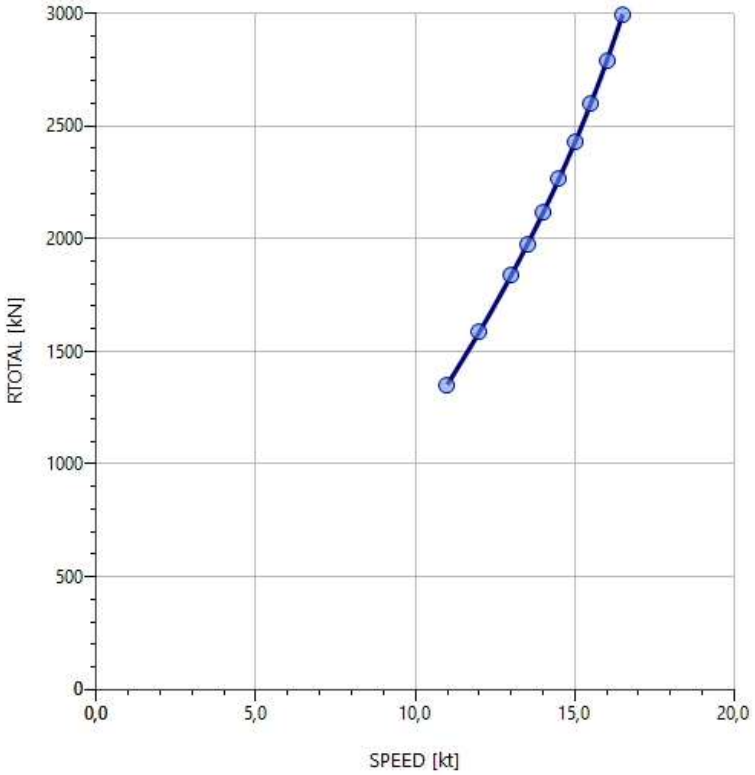
Vessel type	Commercial and naval vessels, Single and twin-screw
Prediction scope	Hull: Data estimates Resistance: Bare-hull resistance Propulsion: Hull-propulsor interaction coefficients
Parameters	Propellers 1··2 CP(LWL) 0.55··0.85 LWL/BWL 3.9··14.9 BWL/T 2.1··4.0 Lambda 0··max determined by FN (see Remarks below) Includes analysis for: Immersed transom and bulbous bow
Speed range	FN(LWL) 0.06··0.80 [see note] **Note:** The upper limit for the speed range may be shown as less than in the original publication. HydroComp has identified and developed an upper speed constraint that is a function of certain hull parameters, notably transom immersion. The *Method Expert* will adjust the upper speed limit of this method based on this constraint.

Una vez obtenidos, se calcula la resistencia total del buque, se obtiene un gráfico que muestra la misma respecto a distintas velocidades y se obtiene el “report” de resistencia. Todo ello mostrado a continuación:

Analysis parameters

Vessel drag		**ITTC-78 (CT)**
Technique:	[Calc]	**Prediction**
Prediction:		**Holtrop**
Reference ship:		
Model LWL:		
Expansion:		**Standard**
Friction line:		**ITTC-57**
Hull form factor:	[On]	**1,399**
Speed corr:	[On]	
Spray drag corr:	[Off]	
Corr allowance:		**ITTC-78 (v2008)**
Roughness [mm]:	[On]	**0,15**

Added drag		
Appendage:	[Calc]	**Percentage**
Wind:	[Calc]	**Taylor**
Seas:		**[Off]**
Shallow/channel:		**[Off]**
Towed:		**[Off]**
Margin:	[Calc]	**Hull + added drag [15%]**
Water properties		
Water type:		**Salt**
Density:		**1026,00 kg/m3**
Viscosity:		**1,18920e-6 m2/s**



Prediction method check [Holtrop]

Parameters	FN [design]	CP	LWL/BWL	BWL/T	Lambda
Value	0,14	0,82	5,47	2,57	1,03
Range	0,06--0,26	0,55--0,85	3,90--14,90	2,10--4,00	0,01--1,07

Prediction results

	SPEED COEFS		ITTC-78 COEFS						
SPEED [kt]	FN	FV	RN	CF	[CV/CF]	CR	dCF	CA	CT
11,00	0,103	0,219	1,47e9	0,001460	1,398	0,000207	0,000000	0,000263	0,002512
12,00	0,112	0,239	1,60e9	0,001445	1,398	0,000200	0,000000	0,000252	0,002472
13,00	0,122	0,259	1,74e9	0,001431	1,398	0,000199	0,000000	0,000241	0,002440
13,50	0,126	0,269	1,80e9	0,001424	1,397	0,000203	0,000000	0,000236	0,002428
14,00	0,131	0,279	1,87e9	0,001418	1,397	0,000209	0,000000	0,000231	0,002421
14,50	0,136	0,289	1,94e9	0,001412	1,396	0,000220	0,000000	0,000226	0,002418
15,00	0,140	0,299	2,00e9	0,001407	1,396	0,000236	0,000000	0,000221	0,002420
+ 15,50 +	0,145	0,309	2,07e9	0,001401	1,395	0,000258	0,000000	0,000216	0,002429
16,00	0,150	0,319	2,14e9	0,001396	1,395	0,000287	0,000000	0,000211	0,002446
16,50	0,154	0,329	2,20e9	0,001391	1,394	0,000325	0,000000	0,000207	0,002471

	RESISTANCE							
SPEED [kt]	RBARE [kN]	RAPP [kN]	RWIND [kN]	RSEAS [kN]	RCHAN [kN]	RTOWED [kN]	RMARGIN [kN]	RTOTAL [kN]
11,00	1090,19	54,51	31,50	0,00	0,00	0,00	176,43	1352,64
12,00	1276,68	63,83	37,49	0,00	0,00	0,00	206,70	1584,71
13,00	1479,16	73,96	44,00	0,00	0,00	0,00	239,57	1836,69
13,50	1587,68	79,38	47,45	0,00	0,00	0,00	257,18	1971,70
14,00	1702,14	85,11	51,03	0,00	0,00	0,00	275,74	2114,02
14,50	1823,65	91,18	54,74	0,00	0,00	0,00	295,44	2265,01
15,00	1953,60	97,68	58,58	0,00	0,00	0,00	316,48	2426,34
+ 15,50 +	2093,71	104,69	62,55	0,00	0,00	0,00	339,14	2600,09
16,00	2246,02	112,30	66,65	0,00	0,00	0,00	363,75	2788,72
16,50	2412,94	120,65	70,88	0,00	0,00	0,00	390,67	2995,14

	EFFECTIVE POWER		OTHER		
SPEED [kt]	PEBARE [kW]	PETOTAL [kW]	CTLR	CTLT	RBARE/W
11,00	6169,3	7654,4	0,00268	0,03262	0,00034
12,00	7881,4	9782,9	0,00260	0,03210	0,00040
13,00	9892,3	12283,3	0,00259	0,03169	0,00047
13,50	11026,5	13693,4	0,00263	0,03154	0,00050
14,00	12259,2	15225,7	0,00272	0,03145	0,00054
14,50	13603,4	16895,7	0,00286	0,03141	0,00058
15,00	15075,3	18723,3	0,00307	0,03144	0,00062
+ 15,50 +	16695,0	20732,8	0,00335	0,03156	0,00066
16,00	18487,2	22954,3	0,00373	0,03177	0,00071
16,50	20481,9	25423,8	0,00422	0,03209	0,00076

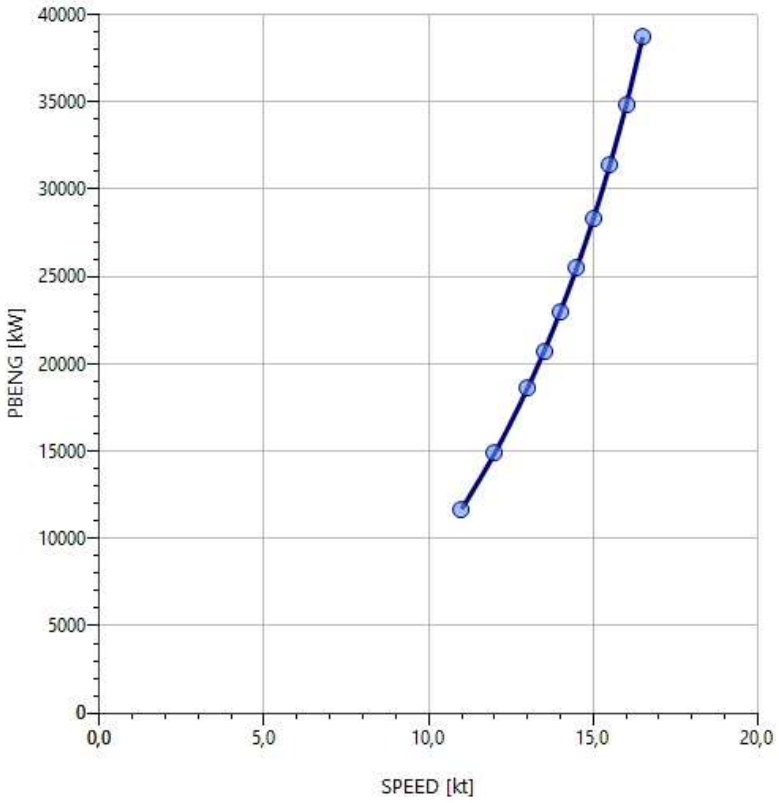
Como se puede observar de la predicción de resistencia, para la velocidad de 15.5 nudos dada por la RPA, se obtiene una resistencia total de:

$$R_{Total} = 2600.09\ kN$$

Tras haber realizado este cálculo, puede llevarse a cabo el estudio de la propulsión; que al igual que con la resistencia, se obtiene un "report" y un gráfico mostrados a continuación:

Analysis parameters

Hull-propulsor interaction		**System analysis**	
Technique:	[Calc] Prediction	Cavitation criteria:	Keller eqn
Prediction:	Holtrop	Analysis type:	Free run
Reference ship:		CPP method:	
Max prop diam:	10130,0 mm	Engine RPM:	
Corrections		Mass multiplier:	
Viscous scale corr:	[Off]	RPM constraint:	
Rudder location:		Limit [RPM/s]:	
Friction line:		**Water properties**	
Hull form factor:		Water type:	Salt
Corr allowance:		Density:	1026,00 kg/m3
Roughness [mm]:		Viscosity:	1,18920e-6 m2/s
Ducted prop corr:	[Off]		
Tunnel stern corr:	[Off]		



Prediction method check [Holtrop]

Parameters	FN [design]	CP	LWL/BWL	BWL/T
Value	0,14	0,82	5,47	2,57
Range	0,06--0,80	0,55--0,85	3,90--14,90	2,10--4,00

Prediction results [System]

	HULL-PROPULSOR				ENGINE			FUEL PER ENGINE	
SPEED [kt]	PETOTAL [kW]	WFT	THD	EFFR	RPMENG [RPM]	PBENG [kW]	LOADENG [% rated]	VOLRATE [L/h]	MASSRATE [t/h]
11,00	7654,4	0,5348	0,2329	1,0160	46	11690,8	0,0	---	---
12,00	9782,9	0,5340	0,2329	1,0160	50	14869,3	0,0	---	---
13,00	12283,3	0,5333	0,2329	1,0160	54	18598,8	0,0	---	---
13,50	13693,4	0,5330	0,2329	1,0160	56	20706,3	0,0	---	---
14,00	15225,7	0,5327	0,2329	1,0160	58	23004,4	0,0	---	---
14,50	16895,7	0,5324	0,2329	1,0160	60	25522,5	0,0	---	---
15,00	18723,3	0,5321	0,2329	1,0160	62	28298,5	0,0	---	---
+ 15,50 +	20732,8	0,5318	0,2329	1,0160	65	31379,7	0,0	---	---
16,00	22954,3	0,5316	0,2329	1,0160	67	34825,5	0,0	---	---
16,50	25423,8	0,5313	0,2329	1,0160	69	38708,9	0,0	---	---

	EFFICIENCY			THRUST	
SPEED [kt]	EFFO	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]
11,00	0,4029	0,6547	0,70674	1763,32	1352,64
12,00	0,4055	0,6579	0,70464	2065,86	1584,71
13,00	0,4077	0,6604	0,70291	2394,34	1836,68
13,50	0,4085	0,6613	0,70224	2570,34	1971,69
14,00	0,4091	0,6619	0,70175	2755,88	2114,02
14,50	0,4095	0,6620	0,70147	2952,71	2265,01
15,00	0,4095	0,6616	0,70145	3163,03	2426,34
+ 15,50 +	0,4092	0,6607	0,70172	3389,52	2600,09
16,00	0,4084	0,6591	0,70233	3635,43	2788,72
16,50	0,4072	0,6568	0,70331	3904,53	2995,14

	POWER DELIVERY							
SPEED [kt]	RPMPROP [RPM]	QPROP [kN-m]	QENG [kN-m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP
11,00	46	2374,60	2374,60	11340,1	11690,8	11690,8	11690,8	---
12,00	50	2785,11	2785,11	14423,2	14869,3	14869,3	14869,3	---
13,00	54	3230,93	3230,93	18040,8	18598,8	18598,8	18598,8	---
13,50	56	3469,66	3469,66	20085,1	20706,3	20706,3	20706,3	---
14,00	58	3721,09	3721,09	22314,3	23004,4	23004,4	23004,4	989,7
14,50	60	3987,45	3987,45	24756,9	25522,5	25522,5	25522,5	923,9
15,00	62	4271,53	4271,53	27449,5	28298,5	28298,5	28298,5	862,0
+ 15,50 +	65	4576,74	4576,74	30438,3	31379,7	31379,7	31379,7	803,3
16,00	67	4907,18	4907,18	33780,8	34825,5	34825,5	34825,5	747,1
16,50	69	5267,66	5267,66	37547,6	38708,9	38708,9	38708,9	693,2

Prediction results [Propulsor]

	CAVITATION								
SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
11,00	75,77	8,58	1,73	24,58	0,398	37,71	2,0	2,0	6263,5
12,00	63,46	7,30	1,47	26,65	0,432	44,18	2,4	2,4	6274,3
13,00	53,91	6,28	1,27	28,73	0,469	51,21 !	2,9	2,9	6283,0
13,50	49,92	5,84	1,18	29,79	0,488	54,97 !	3,2	3,2	6286,4
14,00	46,35	5,44	1,10	30,86	0,509	58,94 !!	3,5	3,5	6288,9
14,50	43,16	5,08	1,02	31,95	0,531	63,15 !!	3,9	3,9	6290,3
15,00	40,28	4,74	0,96	33,07	0,555	67,65 !!	4,3	4,3	6290,4
+ 15,50 +	37,68	4,42	0,89	34,22	0,580	72,49 !!	4,7	4,7	6289,1
16,00	35,32	4,13	0,83	35,43	0,608	77,75 !!	5,3	5,3	6286,0
16,50	33,18	3,85	0,78	36,68	0,638	83,51 !!	5,9	5,9	6281,0

	PROPULSOR COEFS							
SPEED [kt]	J	KT	KQ	KT/J2	KQ/J3	CTH	CP	RNPROP
11,00	0,3365	0,2737	0,03638	2,4168	0,95472	6,1543	15,035	3,31e7
12,00	0,3391	0,2727	0,03629	2,3713	0,93063	6,0384	14,656	3,59e7
13,00	0,3412	0,2718	0,03621	2,3347	0,91144	5,9453	14,353	3,87e7
13,50	0,3420	0,2715	0,03618	2,3209	0,9042	5,91	14,239	4,02e7
14,00	0,3426	0,2713	0,03616	2,3107	0,89892	5,8843	14,156	4,16e7
14,50	0,3430	0,2711	0,03615	2,305	0,89595	5,8697	14,109	4,31e7
15,00	0,3430	0,2711	0,03615	2,3045	0,89568	5,8685	14,105	4,46e7
+ 15,50 +	0,3427	0,2713	0,03616	2,3101	0,89858	5,8826	14,151	4,61e7
16,00	0,3419	0,2716	0,03619	2,3226	0,90512	5,9145	14,254	4,78e7
16,50	0,3407	0,2720	0,03623	2,3431	0,91585	5,9667	14,423	4,95e7

Del resultado obtenido, se deduce, que la potencia al freno necesaria para desplazar el buque a proyectar a 15.5 nudos es de:

$$PB_{TOTAL} = 31379.7\ kW$$

Inicialmente se tenía que:

$$BHP = \frac{24050.97}{0.7457} = 32252.88\ kW$$

Por lo tanto, el resultado obtenido de potencia al freno mediante NAVDAC de 31379.7 kW es una mejora respecto a los 32252.88 BHP de la estimación inicial para los 15.5 nudos de velocidad.

Es importante también, remarcar las revoluciones óptimas estimadas por el programa, habiéndose marcado 66.4 rpm:

$$RPM_{ÓPTIMAS} = 65\ rpm$$

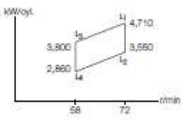
A continuación, se realiza la comprobación de la potencia total requerida por el motor principal del buque a tratar, en la que se debe considerar la potencia de los alternadores de 1540 kW que se tienen previsto instalar, como los del buque base. El margen de régimen del motor (MCR) se considera del 85%, típico en este tipo de motores:

$$\boldsymbol{BHP = \frac{PB_{TOTAL} + 1540}{0.85} = \frac{31379.7 + 1540}{0.85} = 38729.06\ kW}$$

Así, se obtiene una potencia requerida en el motor de prácticamente 38700 kW. Conforme a este dato, se escoge un motor MAN G80ME-C10.5 para buques de baja velocidad y cuya potencia mínima es de 28260 kW y máxima de 42390 kW. El tipo de alimentación puede ser Diésel, gas, de doble combustible o fuel pesado. Sus características extraídas del catálogo son las siguientes:

MAN B&W G80ME-C10.5 — Tier II

Cyl.	L_1 kW	Stroke: 3,720 mm/L_1 MEP: 21.0 bar
6	28,260	
7	32,970	
8	37,680	
9	42,390	



Fuel oil

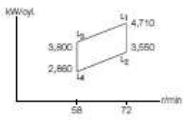
MAN B&W G80ME-C10.5			
L_1 SFOC [g/kWh]			
Opt. load range	50%	75%	100%
High-load	160.5	159.5	164.0
Part-load EPT	158.5	158.0	166.5
Low-load EPT	156.5	159.0	166.5

GI (Methane)

MAN B&W G80ME-C10.5-GI (gas optimised)			
L_1 dual fuel mode (SGC+SPOC (1.5%))/fuel oil mode (SFOC) [g/kWh]			
Gas tuned	50%	75%	100%
Gas optimised	128.6+3.9/159.5	128.5+3.0/162.5	135.4+2.5/167.0

Tier III — **MAN B&W G80ME-C10.5**

Cyl.	L_1 kW	Stroke: 3,720 mm/L_1 MEP: 21.0 bar
6	28,260	
7	32,970	
8	37,680	
9	42,390	



Fuel oil

MAN B&W G80ME-C10.5-EGRTC			
L_1 SFOC [g/kWh]			
	50%	75%	100%
Tier II mode	156.5	159.0	166.0
Tier III mode	162.5	162.5	168.0

MAN B&W G80ME-C10.5-HPSCR			
L_1 SFOC [g/kWh]			
	50%	75%	100%
Tier II mode	156.5	159.0	166.5
Tier III mode	158.0	160.0	167.0

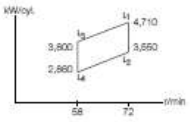
MAN B&W G80ME-C10.5-LPSCR			
L_1 SFOC [g/kWh]			
	50%	75%	100%
Tier II mode	156.5	159.0	166.5
Tier III mode	157.5	160.0	167.5

MAN B&W G80ME-C10.5

Tier III

Cyl.	L_1 kW
6	28,260
7	32,970
8	37,680
9	42,390

Stroke: 3,720 mm/L_1 MEP: 21.0 bar



GI (Methane)

MAN B&W G80ME-C10.5-GI-EGRTC (gas optimised)

L_1 dual fuel mode (SGC+SPOC (1.5%))/fuel oil mode (SFOC) [g/kWh]	50%	75%	100%
Tier II mode	126.9+3.9/159.5	128.5+3.0/162.5	135.4+2.5/167.0
Tier III mode	132.9+3.9/160.5	133.7+3.0/160.5	137.1+2.5/164.0

MAN B&W G80ME-C10.5-GI-HPSCR (gas optimised)

L_1 dual fuel mode (SGC+SPOC (1.5%))/fuel oil mode (SFOC) [g/kWh]	50%	75%	100%
Tier II mode	128.6+3.9/159.5	128.5+3.0/162.5	136.2+2.5/168.0
Tier III mode	130.3+3.9/157.5	132.0+3.0/158.5	136.2+2.5/163.0

MAN B&W G80ME-C10.5-GI-LPSCR (gas optimised)

L_1 dual fuel mode (SGC+SPOC (1.5%))/fuel oil mode (SFOC) [g/kWh]	50%	75%	100%
Tier II mode	128.6+3.9/159.5	128.5+3.0/162.5	136.2+2.5/168.0
Tier III mode	130.3+3.9/157.5	133.7+3.0/160.5	137.1+2.5/164.0

Tier II Tier III

MAN B&W G80ME-C10.5

Specifications

Dimensions:	A	B1	B2	C	H1
mm	1,400	-	5,252	-	-

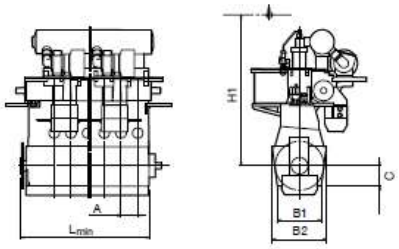
Cylinders:	6	7	8	9
L_{min} mm	-	-	-	-

Dry mass				
Tier II t	898	1,002	1,115*	1,283

Tier III (added)				
EGR t	11	12	13	14
HPSCR t	6	10	10	15
LPSCR t	-	-	-	-

Dual fuel (added)				
GI t	7	8	9	9

* Dry mass and cylinder L_{min} are with undivided crankshaft and chain in aft.



9 ESTIMACIÓN PRELIMINAR DE LOS PESOS

El estudio preliminar para la obtención de los pesos del buque a tratar, se hará siguiendo el libro de Proyectos de Buque y Artefactos del Profesor Fernando Junco Ocampo.

9.1 Estimación del peso muerto

El buque a proyectar presenta un peso muerto fijado en al RPA y con un valor de 275000 TPM. A partir de este dato pueden ser valoradas las demás partidas del buque compuestas por:

- Tripulación
- Víveres, pertrechos
- Consumos
- Carga útil

9.1.1 Consumos

Serán calculados para una autonomía dada en al RPA de 20000 millas náuticas para la velocidad de servicio fijada de 15.5 nudos.

9.1.1.1 Combustibles

Diésel será el combustible principal utilizado. El consumo específico de este tipo de motores se puede aproximar a 165 g/kW*h ya que este valor oscila entre 160-170 g/kW*h.

Para los generadores auxiliares en navegación el consumo estimado es de 190 g/kW*h.

Para el motor principal diésel,

$$Phfo = \frac{Autonomía}{Vs} * BHP * C_{hfo} * 10^{-6}$$

- Autonomía: 20000 millas náuticas.
- Vs: 15.5 nudos
- BHP: 38729.06 CV
- Chfo: 165 g/kW*h

Entonces obtenemos que el peso de combustible del motor principal es,

$$Phfo = 8245.54\ t$$

Para los generadores auxiliares,

$$Phfo = \frac{Autonomía}{Vs} * BHP * C_{hfo} * 10^{-6}$$

- Autonomía: 20000 millas náuticas.
- Vs: 15.5 nudos
- BHP: 1200 CV (buque de referencia)
- Chfo: 190 g/kW*h

Entonces obtenemos que el peso de combustible de los generadores auxiliares,

$$Phfo = 282\ t$$

$$Consumo\ Diesel\ Total = 8245.54 + 282 = 8527.48\ t$$

9.1.1.2 Aceite

Para el tanque de servicio, según la bibliografía indicada, se puede estimar un peso igual al 3% del peso de combustible de propulsión:

$$Consumo\ aceite = 0.03 * Consumo\ Diesel\ Total$$

$$Consumo\ aceite = 255.82\ t$$

Pero, suele haber un tanque de reserva con el mismo tamaño, por lo que el peso se dobla:

$$Consumo\ aceite = 511.65\ t$$

9.1.1.3 Agua de refrigeración

Según la bibliografía, puede aproximarse al 2% del peso de combustible. Igual que los aceites, suele haber un tanque de reserva del mismo tamaño por lo que:

$$Peso\ agua\ de\ refrigeración = 2 * (0.02 * Consumo\ Diesel\ Total)$$

$$Peso\ agua\ de\ refrigeración = 341.1\ t$$

9.1.1.4 Agua dulce

Considerando 150 l por persona y un día, para la tripulación formada por 36 personas para una autonomía de 20000 millas a 15.5 nudos,

$$Consumo\ agua\ dulce = 150\ litros * tripulación * \frac{Autonomía}{Vs * h}$$

$$Consumo\ agua\ dulce = 290322058\ litros \approx 290\ t$$

9.1.1.5 Víveres

En el tipo de buque a tratar, se considera 5kg por persona y día, por tanto:

$$Consumo\ Víveres = 5 * tripulación * \frac{Autonomía}{Vs * h}$$

$$Consumo\ Víveres = 9677.42\ kg \approx 9.7\ t$$

La suma de todas las partidas anteriores resulta en el peso total de los consumos,

$$Consumos = 9679.93\ t$$

9.1.2 Tripulación

Al tratarse de un buque de transporte de mercancía no hay pasaje y, según la bibliografía, se considera 125 kg por cada tripulante. Por tanto,

$$Peso\ tripulación = 125 * 36 = 4500 = 4.5\ t$$

9.1.3 Pertrechos

Los elementos considerados como pertrechos son aquellos no consumibles, que el Armador considera necesario añadir como repuestos o necesidades adicionales del buque. La cifra es muy variable al depender estos de la consideración de cada Armador, aún así, su variación es entre 10 y 100 t según el tamaño del buque.

Para el buque a proyectar, al ser este relativamente grande, se toma un valor de 75 t.

9.1.4 Carga útil

El peso de la carga útil viene dado por la diferencia entre el peso muerto, dado por la RPA (275000 TPM), y el resto de los pesos en los que se descompone.

$$Carga\ útil = TPM - Peso\ Consumos - Peso\ Tripulación - Peso\ Pertrechos$$

$$\boldsymbol{Carga\ útil = 265240.58\ t\ de\ carga\ útil}$$

9.2 Estimación del peso en Rosca

El peso en rosca, a grandes rasgos, se desglosa en tres partidas: peso estructural (PA), peso de la maquinaria (PQ) y peso del equipo y habilitación (PE).

$$PR = PS + PQ + PE$$

El peso en rosca del buque a proyectar es determinado mediante el uso de la fórmula descrita en el libre de Proyectos de Buques y Artefactos para petroleros de doble casco:

$$WR = 0.0595 * L^{1.65} * B^{0.875} + 0.349 * BHP^{0.893} + 25.07 * TPM^{0.381}$$

$$\boldsymbol{WR = 34328.37\ t}$$

Se debe comprobar que el peso en rosca obtenido junto con el peso muerto fijado en la RPA se corresponde con el desplazamiento obtenido de formas:

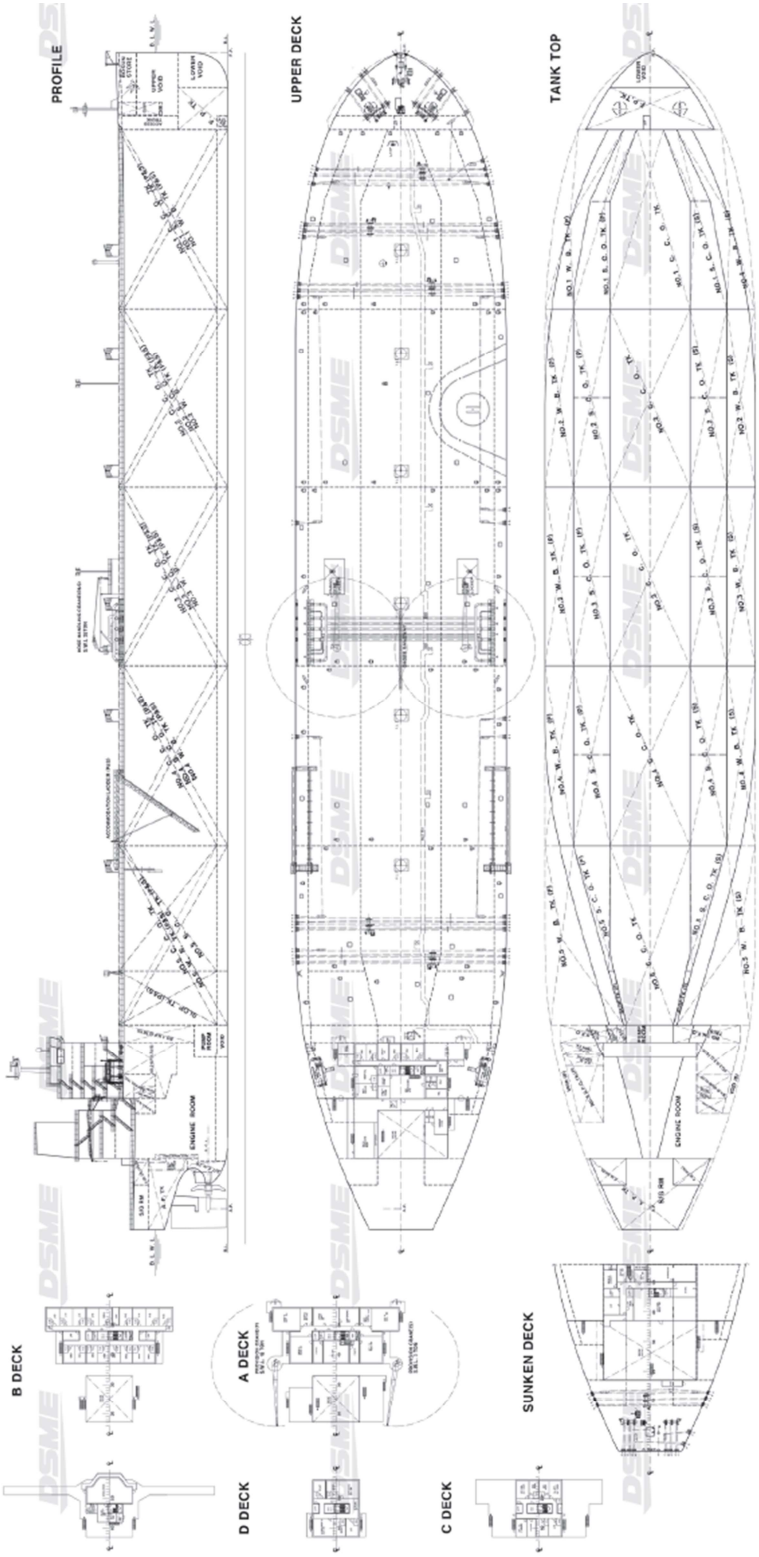
$$\Delta = WR + TPM$$

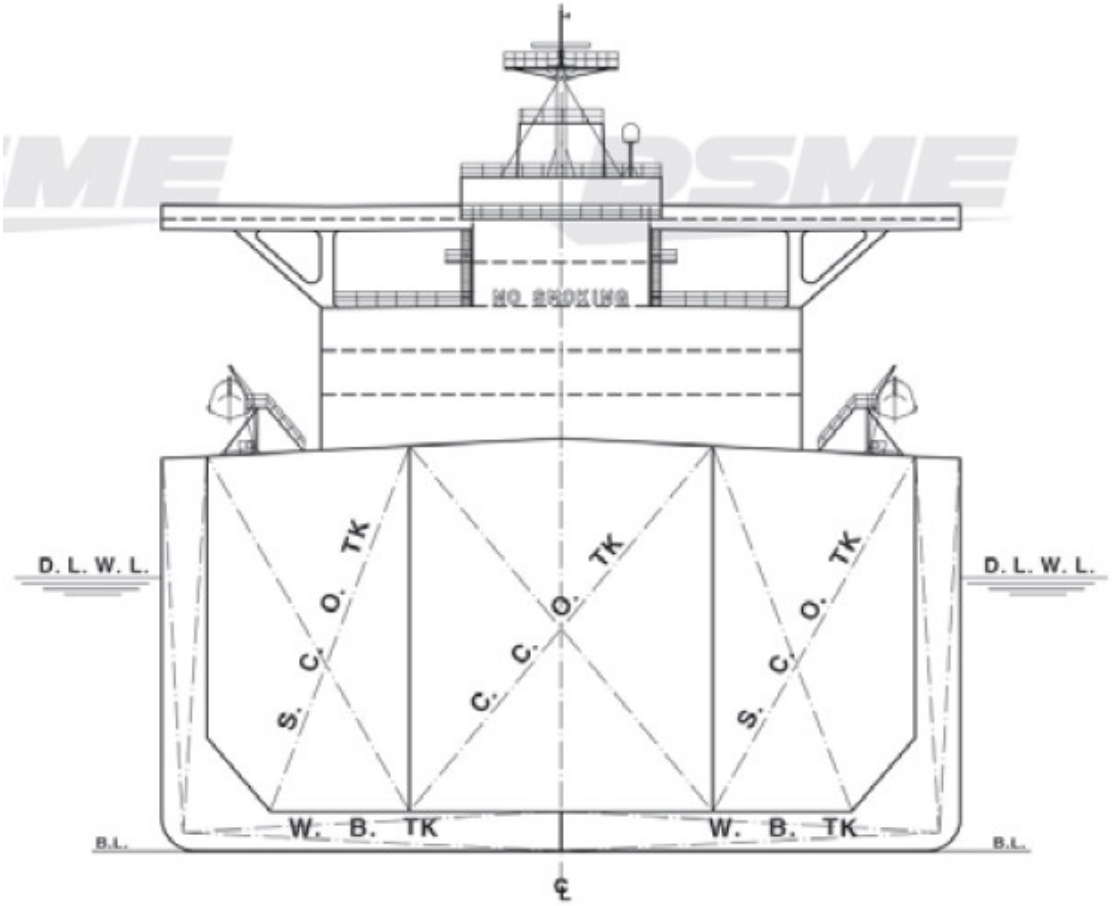
$$322340.48 = 34328.37 + TPM \quad \rightarrow \quad TPM = 288012.11$$

Se puede observar el cumplimiento del requerimiento previo de 275000 TPM con unas 13000 t de margen.

10 CROQUIS DE LA DISPOSICIÓN GENERAL Y DE LA SECCIÓN TRANSVERSAL

Para completar este apartado, se adjunta la disposición general del buque de referencia Hunter Atla que consta de 15 tanques para carga (5 centrales y 10 laterales) además de 2 para aguas residuales. También se adjunta su sección media característica.





MIDSHIP SECTION

RIVAS CABANAS MINERVA - 34284839G

Firmado digitalmente por RIVAS CABANAS MINERVA - 34284839G
Fecha: 2021.07.21 10:19:24 +02'00'

11 BIBLIOGRAFÍA

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12 ANEXO I: FRANCOBORDO

INTERNATIONAL CONVENTION ON LOAD LINES 1966/1988

Moulded Breadth (B)	56,5	m	Lpp
Least Moulded Depth	29,4	m	B
85% Least Moulded Depth	25,0	m	D
Freeboard deck thickness at side	10,0	mm	T
Freeboard Depth (D)	29,4	m	Fn
			Cp
Lenght of the waterline at 24,99 m of depth	308,9	m	Cm
Lenght betw. Perp. at 24,99 m of depth	308,9	m	Cb
Freeboard Lenght (L)	308,9	m	
Volume without appendages at 24,99 m of depth	357640,3	m^3	
Block coefficient	0,82		
			Dwt
Recess in freeboard deck, side to side, of	0,0	m < 1m	

Upper line of the exposed deck is the freeboard deck

R-27 Types of ships — *Applicable*

Type of ship (A,B,Br,B60) A

R-28 Tabular Freeboard — *Applicable*

L	*freeboard*
308,9	3294,7

R-28 3294,7

R-29 Correction for ships under 100 m in lenght — *Not Applicable*

Effective lenght of superestructure (E)	18	m
Lenght of trunks	0	m
Effective lenght of superestructure (E1)	18	m

R-29

R-30 Correction for block coefficient — *Applicable*

R-28	3294,7
R-29	
freeboard	3294,7

Factor 1,1029

R-30 340

R-31 Correction for depth — *Applicable*

Enclosed superestructure lenght	20	m	<0.6*L
Height of superestructure	1	m	
Standard Height	1,7	m	

R 250 — Standard Height correction 0,5882

Correction 2204,17

R-31 2204,17

R-32 Correction for position of deck line — *Not Applicable*

R-32

R-32.1 Correction for recess in freeboard deck (not side to side) — *Not Applicable*

Volume of the recess	m^3
Waterplane area at 24,99 m draft	m^2

R-32.1

R-33 Standard height of superstructure (in m) — *Applicable*

Raised quarterdeck	*All Other superestructures*
2,3	2,3

R-34/35 Effective lenght of superstructure (in m) — *Applicable*

Superestructure	*Lenght (S)*	*Sup. br. (b)*	*Ship br. (Bs)*	*Height*	*Effective Lenght (E)*
Forecastle	20,000	56,500	56,500	1,000	20,00

Raised quarterdeck	*Lenght (S)*	*Sup. br. (b)*	*Ship br. (Bs)*	*Height*	*Effective Lenght (E)*

R-36 Effective lenght of trunks (in m) — *Applicable*

Trunk	*Lenght (S)*	*Sup. br. (b)*	*Ship br. (Bs)*	*Height*	*Effective Lenght (E)*
Centre	0,000				0,000

R-37 Deduction for superstructures and trunks — *Applicable*

			x	y
Lenght of Superestructure	20,000	m	L (m)	Francobordo (mm)
Lenght of Trunks	0	m	24	350
Effective Lenght (E)	20,000	m	85	860
Effective Lenght (E)	0,0647	*L		
Deduction for 1L	1070	mm		

R37 Table 37.1	
E	%
0	0
0,0647	*-4,529*
0,3	21

R-37 48,47

R-38 Sheer *Applicable*

Standard Sheer Profile

Station	*Ordinate*	*Factor*	*Product*		
After perpendicular	2824	1	2824		
1/6 L from A.P.	1254	3	3762		
1/3 L from A.P.	316	3	948		
Amidships	0	1	0	After Sheer	7534
Amidships	0	1	0		
1/3 L from A.P.	633	3	1899		
1/6 L from A.P.	2508	3	7524		
Forward perpendicular	5648	1	5648	Forward Sheer	15071

Sheer Profile

Station	*Ordinate*	*Sum for Le=L*	*Total*	*Factor*	*Product*	*Si no t*
After perpendicular	0	0	0	1	0	
1/6 L from A.P.	0	0	0	3	0	
1/3 L from A.P.	0	0	0	3	0	
Amidships	0	0	0	1	0	After Sheer
Amidships	0	0	0	1	0	
1/3 L from F.P.	0	0	0	3	0	
1/6 L from F.P.	0	0	0	3	0	
Forward perpendicular	0	0	0	1	0	Forward Sheer

Forward and After corrections for Sheer be allowed

Corrected After Product Difference -7534
Corrected Forward Product Difference -15071

Sheer credit for poop or forecastle

	Real	**Standard**	**Difference**	**s**
Forecastle	1000	2300	-1300	-28
Poop	0	0	0	0

After Sheer variation -941
Forward Sheer variation -1911
Sheer variation -1426

Total lenght of enclosed superestructures (S1) 20,000 m
Extension in midships of superestructures (over L) 0 *L

Factor 0,7176 Correction 1024 mm

Freeboard correction 1024 mm

R-38 1024

R-39.1 Minimum bow height *Applicable*

Waterplane area forward of L/2 at draught d1 (Awf) m2

L 308,9 d1 24,99
B 56,5 Cb 0,82
Cwf 0,89

Minimun bow height (Fb) 6776 mm

Bow depth corrected for R39 13,595 m
Minimum bow heigth freeboard 22591 mm
Salt water freeboard 6814,4 mm

R-39.1 0

R-39.2 Reserve of bouyancy *Not Applicable*

F0 3294,7 mm
f1 1,1029
f2 2204,17 mm
fmin 5838 mm

Minimun projected area m2
Actual projected area 110,45 m2
Freeboard correction 0 mm

R-39.2 0

R-40 Minimum freeboards	*Applicable*

Minimun freeboard without R-32 50 mm

R-28	3294,7	mm	Freeboard in Salt Water	6814,4	mm
R-29		mm			
R-30	340	mm	*Minimun Summer Freeboard*	*6814,4*	*mm*
R-31	2204,17	mm	*Maximun Summer Draught*	*22595,6*	*mm*
R-32.1		mm			
R-37	-48,47	mm	Maximun Scantling Draught	21970	mm
R-38	1024	mm	Maximun Stability Draught	21970	mm
Sum	**6814,4**	**mm**			

R-39.1	0	mm	***Summer Freeboard***	***6814,4***	***mm***
R-39.2	0	mm	***Summer Draught***	***21970***	***mm***
Sum	**6814,4**	**mm**	***Tropical Freeboard***	***7440***	***mm***
			Winter Freeboard	***7273***	***mm***
R-32	0	mm	***Winter N. Atlantic Freeboard***	***7273***	***mm***
			Fresh Water	***6764***	***mm***

13 ANEXO II: RESISTENCIA AL AVANCE (ESTIMACIÓN)

Resistance

23 nov 2020 07:35
HydroComp NavCad 2018

Project ID **Petrolero de crudo 275000 TPM**
Description
File name **BUQUE PBAM I.hcnc**

Analysis parameters

Vessel drag		Added drag	
Technique:	[Calc] Prediction	Appendage:	[Calc] Percentage
Prediction:	Holtrop	Wind:	[Calc] Taylor
Reference ship:		Seas:	[Off]
Model LWL:		Shallow/channel:	[Off]
Expansion:	Standard	Towed:	[Off]
Friction line:	ITTC-57	Margin:	[Calc] Hull + added drag [15%]
Hull form factor:	[On] 1,399	**Water properties**	
Speed corr:	[On]	Water type:	Salt
Spray drag corr:	[Off]	Density:	1026,00 kg/m3
Corr allowance:	ITTC-78 (v2008)	Viscosity:	1,18920e-6 m2/s
Roughness [mm]:	[On] 0,15		

Prediction method check [Holtrop]

Parameters	FN [design]	CP	LWL/BWL	BWL/T	Lambda
Value	0,14	0,82	5,47	2,57	1,03
Range	0,06··0,26	0,55··0,85	3,90··14,90	2,10··4,00	0,01··1,07

Prediction results

	SPEED COEFS		ITTC-78 COEFS						
SPEED [kt]	FN	FV	RN	CF	[CV/CF]	CR	dCF	CA	CT
11,00	0,103	0,219	1,47e9	0,001460	1,398	0,000207	0,000000	0,000263	0,002512
12,00	0,112	0,239	1,60e9	0,001445	1,398	0,000200	0,000000	0,000252	0,002472
13,00	0,122	0,259	1,74e9	0,001431	1,398	0,000199	0,000000	0,000241	0,002440
13,50	0,126	0,269	1,80e9	0,001424	1,397	0,000203	0,000000	0,000236	0,002428
14,00	0,131	0,279	1,87e9	0,001418	1,397	0,000209	0,000000	0,000231	0,002421
14,50	0,136	0,289	1,94e9	0,001412	1,396	0,000220	0,000000	0,000226	0,002418
15,00	0,140	0,299	2,00e9	0,001407	1,396	0,000236	0,000000	0,000221	0,002420
+ 15,50 +	0,145	0,309	2,07e9	0,001401	1,395	0,000258	0,000000	0,000216	0,002429
16,00	0,150	0,319	2,14e9	0,001396	1,395	0,000287	0,000000	0,000211	0,002446
16,50	0,154	0,329	2,20e9	0,001391	1,394	0,000325	0,000000	0,000207	0,002471

	RESISTANCE							
SPEED [kt]	RBARE [kN]	RAPP [kN]	RWIND [kN]	RSEAS [kN]	RCHAN [kN]	RTOWED [kN]	RMARGIN [kN]	RTOTAL [kN]
11,00	1090,19	54,51	31,50	0,00	0,00	0,00	176,43	1352,64
12,00	1276,68	63,83	37,49	0,00	0,00	0,00	206,70	1584,71
13,00	1479,16	73,96	44,00	0,00	0,00	0,00	239,57	1836,69
13,50	1587,68	79,38	47,45	0,00	0,00	0,00	257,18	1971,70
14,00	1702,14	85,11	51,03	0,00	0,00	0,00	275,74	2114,02
14,50	1823,65	91,18	54,74	0,00	0,00	0,00	295,44	2265,01
15,00	1953,60	97,68	58,58	0,00	0,00	0,00	316,48	2426,34
+ 15,50 +	2093,71	104,69	62,55	0,00	0,00	0,00	339,14	2600,09
16,00	2246,02	112,30	66,65	0,00	0,00	0,00	363,75	2788,72
16,50	2412,94	120,65	70,88	0,00	0,00	0,00	390,67	2995,14

	EFFECTIVE POWER		OTHER		
SPEED [kt]	PEBARE [kW]	PETOTAL [kW]	CTLR	CTLT	RBARE/W
11,00	6169,3	7654,4	0,00268	0,03262	0,00034
12,00	7881,4	9782,9	0,00260	0,03210	0,00040
13,00	9892,3	12283,3	0,00259	0,03169	0,00047
13,50	11026,5	13693,4	0,00263	0,03154	0,00050
14,00	12259,2	15225,7	0,00272	0,03145	0,00054
14,50	13603,4	16895,7	0,00286	0,03141	0,00058
15,00	15075,3	18723,3	0,00307	0,03144	0,00062
+ 15,50 +	16695,0	20732,8	0,00335	0,03156	0,00066
16,00	18487,2	22954,3	0,00373	0,03177	0,00071
16,50	20481,9	25423,8	0,00422	0,03209	0,00076

Resistance

23 nov 2020 07:35
HydroComp NavCad 2018

Project ID **Petrolero de crudo 275000 TPM**
Description
File name **BUQUE PBAM I.hcnc**

Hull data

General		
Configuration:		**Monohull**
Chine type:		**Round/multiple**
Length on WL:		**308,900 m**
Max beam on WL:	[LWL/BWL 5,467]	**56,500 m**
Max molded draft:	[BWL/T 2,572]	**21,970 m**
Displacement:	[CB 0,819]	**322340,48 t**
Wetted surface:	[CS 2,682]	**26421,900 m2**

ITTC-78 (CT)		
LCB fwd TR:	[XCB/LWL 0,518]	**160,100 m**
LCF fwd TR:	[XCF/LWL 0,512]	**158,276 m**
Max section area:	[CX 0,995]	**1235,100 m2**
Waterplane area:	[CWP 0,888]	**15501,300 m2**
Bulb section area:		**0,000 m2**
Bulb ctr below WL:		**0,000 m**
Bulb nose fwd TR:		**0,000 m**
Imm transom area:	[ATR/AX 0,036]	**44,194 m2**
Transom beam WL:	[BTR/BWL 0,000]	**0,000 m**
Transom immersion:	[TTR/T 0,000]	**0,000 m**
Half entrance angle:		**49,52 deg**
Bow shape factor:	[AVG flow]	**0,0**
Stern shape factor:	[WL flow]	**1,0**

Planing		
Proj chine length:		***0,000 m***
Proj bottom area:		***0,000 m2***
LCG fwd TR:	*[XCG/LP 0,000]*	***0,000 m***
VCG below WL:		***0,000 m***
Aft station (fwd TR):		***0,000 m***
Deadrise:		***0,00 deg***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Fwd station (fwd TR):		***0,000 m***
Deadrise:		***0,00 deg***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Propulsor type:		***Propeller***
Max prop diameter:		***0,0 mm***
Shaft angle to WL:		***0,00 deg***
Position fwd TR:		***0,000 m***
Position below WL:		***0,000 m***
Transom lift device:		***Flap***
Device count:		***0***
Span:		***0,000 m***
Chord length:		***0,000 m***
Deflection angle:		***0,00 deg***
Tow point fwd TR:		***0,000 m***
Tow point below WL:		***0,000 m***

Resistance

23 nov 2020 07:35
HydroComp NavCad 2018

Project ID **Petrolero de crudo 275000 TPM**
Description
File name **BUQUE PBAM I.hcnc**

Appendage data

General	
Definition:	**Percentage**
Percent of hull drag:	**5,00 %**
Planing influence	
LCE fwd TR:	**0,000 m**
VCE below WL:	**0,000 m**
Shafting	
Count:	**1**
Max prop diameter:	**0,0 mm**
Shaft angle to WL:	**0,00 deg**
Exposed shaft length:	**0,000 m**
Shaft diameter:	**0,000 m**
Wetted surface:	**0,000 m2**
Strut bossing length:	**0,000 m**
Bossing diameter:	**0,000 m**
Wetted surface:	**0,000 m2**
Hull bossing length:	**0,000 m**
Bossing diameter:	**0,000 m**
Wetted surface:	**0,000 m2**
Strut (per shaft line)	
Count:	**0**
Root chord:	**0,000 m**
Tip chord:	**0,000 mm**
Span:	**0,000 m**
T/C ratio:	**0,000**
Projected area:	**0,000 m2**
Wetted surface:	**0,000 m2**
Exposed palm depth:	**0,000 m**
Exposed palm width:	**0,000 m**
Rudder	
Count:	**0**
Rudder location:	**Behind propeller**
Type:	**Balanced foil**
Root chord:	**0,000 m**
Tip chord:	**0,000 m**
Span:	**0,000 m**
T/C ratio:	**0,000**
LE sweep:	**0,00 deg**
Projected area:	**0,000 m2**
Wetted surface:	**0,000 m2**

Skeg/Keel	
Count:	**0**
Type:	**Skeg**
Mean length:	**0,000 m**
Mean width:	**0,000 m**
Height aft:	**0,000 m**
Height mid:	**0,000 m**
Height fwd:	**0,000 m**
Projected area:	**0,000 m2**
Wetted surface:	**0,000 m2**
Stabilizer	
Count:	**0**
Root chord:	**0,000 m**
Tip chord:	**0,000 m**
Span:	**0,000 m**
T/C ratio:	**0,000**
LE sweep:	**0,00 deg**
Wetted surface:	**0,000 m2**
Projected area:	**0,000 m2**
Dynamic multiplier:	**1,00**
Bilge keel	
Count:	**0**
Mean length:	**0,000 m**
Mean base width:	**0,000 m**
Mean projection:	**0,000 m**
Wetted surface:	**0,000 m2**
Tunnel thruster	
Count:	**0**
Diameter:	**0,000 m**
Sonar dome	
Count:	**0**
Wetted surface:	**0,000 m2**
Miscellaneous	
Count:	**0**
Drag area:	**0,000 m2**
Drag coef:	**0,00**

Environment data

Wind	
Wind speed:	**0,00 kt**
Angle off bow:	**0,00 deg**
Gradient correction:	**Off**
Exposed hull	
Transverse area:	**1276,900 m2**
VCE above WL:	**26,470 m**
Profile area:	**4293,864 m2**
Superstructure	
Superstructure shape:	**Tanker/Bulker**
Transverse area:	**861,908 m2**
VCE above WL:	**46,000 m**
Profile area:	**4293,864 m2**

Seas	
Significant wave ht:	**0,000 m**
Modal wave period:	**0,0 sec**
Shallow/channel	
Water depth:	**0,000 m**
Type:	**Shallow water**
Channel width:	**0,000 m**
Channel side slope:	**0,00 deg**
Hull girth:	**0,000 m**

Resistance

23 nov 2020 07:35

HydroComp NavCad 2018

Project ID **Petrolero de crudo 275000 TPM**

Description

File name **BUQUE PBAM I.hcnc**

Symbols and values

SPEED =	Vessel speed
FN =	Froude number [LWL]
FV =	Froude number [VOL]
RN =	Reynolds number [LWL]
CF =	Frictional resistance coefficient
CV/CF =	Viscous/frictional resistance coefficient ratio [dynamic form factor]
CR =	Residuary resistance coefficient
dCF =	Added frictional resistance coefficient for roughness
CA =	Correlation allowance [dynamic]
CT =	Total bare-hull resistance coefficient
RBARE =	Bare-hull resistance
RAPP =	Additional appendage resistance
RWIND =	Additional wind resistance
RSEAS =	Additional sea-state resistance
RCHAN =	Additional shallow/channel resistance
RTOWED =	Additional towed object resistance
RMARGIN =	Resistance margin
RTOTAL =	Total vessel resistance
PEBARE =	Bare-hull effective power
PETOTAL =	Total effective power
CTLR =	Telfer residuary resistance coefficient
CTLT =	Telfer total bare-hull resistance coefficient
RBARE/W =	Bare-hull resistance to weight ratio
+ =	Design speed indicator
* =	Exceeds parameter limit

14 ANEXO III: POTENCIA PROPULSIÓN (ESTIMACIÓN)

Propulsion

23 nov 2020 08:00
HydroComp NavCad 2018

Project ID **Petrolero de crudo 275000 TPM**
Description
File name **BUQUE PBAM I.hcnc**

Analysis parameters

Hull-propulsor interaction		System analysis	
Technique:	**[Calc] Prediction**	Cavitation criteria:	**Keller eqn**
Prediction:	**Holtrop**	Analysis type:	**Free run**
Reference ship:		CPP method:	
Max prop diam:	**10130,0 mm**	Engine RPM:	
Corrections		Mass multiplier:	
Viscous scale corr:	**[Off]**	RPM constraint:	
Rudder location:		Limit [RPM/s]:	
Friction line:		**Water properties**	
Hull form factor:		Water type:	**Salt**
Corr allowance:		Density:	**1026,00 kg/m3**
Roughness [mm]:		Viscosity:	**1,18920e-6 m2/s**
Ducted prop corr:	**[Off]**		
Tunnel stern corr:	**[Off]**		

Prediction method check [Holtrop]

Parameters	FN [design]	CP	LWL/BWL	BWL/T
Value	**0,14**	**0,82**	**5,47**	**2,57**
Range	**0,06··0,80**	**0,55··0,85**	**3,90··14,90**	**2,10··4,00**

Prediction results [System]

	HULL-PROPULSOR				ENGINE			FUEL PER ENGINE	
SPEED [kt]	PETOTAL [kW]	WFT	THD	EFFR	RPMENG [RPM]	PBENG [kW]	LOADENG [% rated]	VOLRATE [L/h]	MASSRATE [t/h]
11,00	**7654,4**	**0,5348**	**0,2329**	**1,0160**	**46**	**11690,8**	**0,0**	**---**	**---**
12,00	**9782,9**	**0,5340**	**0,2329**	**1,0160**	**50**	**14869,3**	**0,0**	**---**	**---**
13,00	**12283,3**	**0,5333**	**0,2329**	**1,0160**	**54**	**18598,8**	**0,0**	**---**	**---**
13,50	**13693,4**	**0,5330**	**0,2329**	**1,0160**	**56**	**20706,3**	**0,0**	**---**	**---**
14,00	**15225,7**	**0,5327**	**0,2329**	**1,0160**	**58**	**23004,4**	**0,0**	**---**	**---**
14,50	**16895,7**	**0,5324**	**0,2329**	**1,0160**	**60**	**25522,5**	**0,0**	**---**	**---**
15,00	**18723,3**	**0,5321**	**0,2329**	**1,0160**	**62**	**28298,5**	**0,0**	**---**	**---**
+ 15,50 +	**20732,8**	**0,5318**	**0,2329**	**1,0160**	**65**	**31379,7**	**0,0**	**---**	**---**
16,00	**22954,3**	**0,5316**	**0,2329**	**1,0160**	**67**	**34825,5**	**0,0**	**---**	**---**
16,50	**25423,8**	**0,5313**	**0,2329**	**1,0160**	**69**	**38708,9**	**0,0**	**---**	**---**

	EFFICIENCY			THRUST	
SPEED [kt]	EFFO	EFFOA	MERIT	THRPROP [kN]	DELTHR [kN]
11,00	**0,4029**	**0,6547**	**0,70674**	**1763,32**	**1352,64**
12,00	**0,4055**	**0,6579**	**0,70464**	**2065,86**	**1584,71**
13,00	**0,4077**	**0,6604**	**0,70291**	**2394,34**	**1836,68**
13,50	**0,4085**	**0,6613**	**0,70224**	**2570,34**	**1971,69**
14,00	**0,4091**	**0,6619**	**0,70175**	**2755,88**	**2114,02**
14,50	**0,4095**	**0,6620**	**0,70147**	**2952,71**	**2265,01**
15,00	**0,4095**	**0,6616**	**0,70145**	**3163,03**	**2426,34**
+ 15,50 +	**0,4092**	**0,6607**	**0,70172**	**3389,52**	**2600,09**
16,00	**0,4084**	**0,6591**	**0,70233**	**3635,43**	**2788,72**
16,50	**0,4072**	**0,6568**	**0,70331**	**3904,53**	**2995,14**

	POWER DELIVERY							
SPEED [kt]	RPMPROP [RPM]	QPROP [kN·m]	QENG [kN·m]	PDPROP [kW]	PSPROP [kW]	PSTOTAL [kW]	PBTOTAL [kW]	TRANSP
11,00	**46**	**2374,60**	**2374,60**	**11340,1**	**11690,8**	**11690,8**	**11690,8**	**---**
12,00	**50**	**2785,11**	**2785,11**	**14423,2**	**14869,3**	**14869,3**	**14869,3**	**---**
13,00	**54**	**3230,93**	**3230,93**	**18040,8**	**18598,8**	**18598,8**	**18598,8**	**---**
13,50	**56**	**3469,66**	**3469,66**	**20085,1**	**20706,3**	**20706,3**	**20706,3**	**---**
14,00	**58**	**3721,09**	**3721,09**	**22314,3**	**23004,4**	**23004,4**	**23004,4**	**989,7**
14,50	**60**	**3987,45**	**3987,45**	**24756,9**	**25522,5**	**25522,5**	**25522,5**	**923,9**
15,00	**62**	**4271,53**	**4271,53**	**27449,5**	**28298,5**	**28298,5**	**28298,5**	**862,0**
+ 15,50 +	**65**	**4576,74**	**4576,74**	**30438,3**	**31379,7**	**31379,7**	**31379,7**	**803,3**
16,00	**67**	**4907,18**	**4907,18**	**33780,8**	**34825,5**	**34825,5**	**34825,5**	**747,1**
16,50	**69**	**5267,66**	**5267,66**	**37547,6**	**38708,9**	**38708,9**	**38708,9**	**693,2**

Propulsion

23 nov 2020 08:00

HydroComp NavCad 2018

Project ID **Petrolero de crudo 275000 TPM**

Description

File name **BUQUE PBAM I.hcnc**

Prediction results [Propulsor]

	CAVITATION								
SPEED [kt]	SIGMAV	SIGMAN	SIGMA07R	TIPSPEED [m/s]	MINBAR	PRESS [kPa]	CAVAVG [%]	CAVMAX [%]	PITCHFC [mm]
11,00	**75,77**	**8,58**	**1,73**	**24,58**	**0,398**	**37,71**	**2,0**	**2,0**	**6263,5**
12,00	**63,46**	**7,30**	**1,47**	**26,65**	**0,432**	**44,18**	**2,4**	**2,4**	**6274,3**
13,00	**53,91**	**6,28**	**1,27**	**28,73**	**0,469**	**51,21 !**	**2,9**	**2,9**	**6283,0**
13,50	**49,92**	**5,84**	**1,18**	**29,79**	**0,488**	**54,97 !**	**3,2**	**3,2**	**6286,4**
14,00	**46,35**	**5,44**	**1,10**	**30,86**	**0,509**	**58,94 !!**	**3,5**	**3,5**	**6288,9**
14,50	**43,16**	**5,08**	**1,02**	**31,95**	**0,531**	**63,15 !!**	**3,9**	**3,9**	**6290,3**
15,00	**40,28**	**4,74**	**0,96**	**33,07**	**0,555**	**67,65 !!**	**4,3**	**4,3**	**6290,4**
+ 15,50 +	**37,68**	**4,42**	**0,89**	**34,22**	**0,580**	**72,49 !!**	**4,7**	**4,7**	**6289,1**
16,00	**35,32**	**4,13**	**0,83**	**35,43**	**0,608**	**77,75 !!**	**5,3**	**5,3**	**6286,0**
16,50	**33,18**	**3,85**	**0,78**	**36,68**	**0,638**	**83,51 !!**	**5,9**	**5,9**	**6281,0**

	PROPULSOR COEFS								
SPEED [kt]	J	KT	KQ	KT/J2	KQ/J3	CTH	CP	RNPROP	
11,00	**0,3365**	**0,2737**	**0,03638**	**2,4168**	**0,95472**	**6,1543**	**15,035**	**3,31e7**	
12,00	**0,3391**	**0,2727**	**0,03629**	**2,3713**	**0,93063**	**6,0384**	**14,656**	**3,59e7**	
13,00	**0,3412**	**0,2718**	**0,03621**	**2,3347**	**0,91144**	**5,9453**	**14,353**	**3,87e7**	
13,50	**0,3420**	**0,2715**	**0,03618**	**2,3209**	**0,9042**	**5,91**	**14,239**	**4,02e7**	
14,00	**0,3426**	**0,2713**	**0,03616**	**2,3107**	**0,89892**	**5,8843**	**14,156**	**4,16e7**	
14,50	**0,3430**	**0,2711**	**0,03615**	**2,305**	**0,89595**	**5,8697**	**14,109**	**4,31e7**	
15,00	**0,3430**	**0,2711**	**0,03615**	**2,3045**	**0,89568**	**5,8685**	**14,105**	**4,46e7**	
+ 15,50 +	**0,3427**	**0,2713**	**0,03616**	**2,3101**	**0,89858**	**5,8826**	**14,151**	**4,61e7**	
16,00	**0,3419**	**0,2716**	**0,03619**	**2,3226**	**0,90512**	**5,9145**	**14,254**	**4,78e7**	
16,50	**0,3407**	**0,2720**	**0,03623**	**2,3431**	**0,91585**	**5,9667**	**14,423**	**4,95e7**	

Propulsion

23 nov 2020 08:00
HydroComp NavCad 2018

Project ID **Petrolero de crudo 275000 TPM**
Description
File name **BUQUE PBAM I.hcnc**

Hull data

General		
Configuration:		**Monohull**
Chine type:		**Round/multiple**
Length on WL:		**308,900 m**
Max beam on WL:	[LWL/BWL 5,467]	**56,500 m**
Max molded draft:	[BWL/T 2,572]	**21,970 m**
Displacement:	[CB 0,819]	**322340,48 t**
Wetted surface:	[CS 2,682]	**26421,900 m2**

ITTC-78 (CT)		
LCB fwd TR:	[XCB/LWL 0,518]	**160,100 m**
LCF fwd TR:	[XCF/LWL 0,512]	**158,276 m**
Max section area:	[CX 0,995]	**1235,100 m2**
Waterplane area:	[CWP 0,888]	**15501,300 m2**
Bulb section area:		**0,000 m2**
Bulb ctr below WL:		**0,000 m**
Bulb nose fwd TR:		**0,000 m**
Imm transom area:	[ATR/AX 0,036]	**44,194 m2**
Transom beam WL:	[BTR/BWL 0,000]	**0,000 m**
Transom immersion:	[TTR/T 0,000]	**0,000 m**
Half entrance angle:		**49,52 deg**
Bow shape factor:	[AVG flow]	**0,0**
Stern shape factor:	[WL flow]	**1,0**

Planing		
Proj chine length:		***0,000 m***
Proj bottom area:		***0,000 m2***
LCG fwd TR:	*[XCG/LP 0,000]*	***0,000 m***
VCG below WL:		***0,000 m***
Aft station (fwd TR):		***0,000 m***
Deadrise:		***0,00 deg***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Fwd station (fwd TR):		***0,000 m***
Deadrise:		***0,00 deg***
Chine beam:		***0,000 m***
Chine ht below WL:		***0,000 m***
Propulsor type:		***Propeller***
Max prop diameter:		***10130,0 mm***
Shaft angle to WL:		***0,00 deg***
Position fwd TR:		***0,000 m***
Position below WL:		***0,000 m***
Transom lift device:		***Flap***
Device count:		***0***
Span:		***0,000 m***
Chord length:		***0,000 m***
Deflection angle:		***0,00 deg***
Tow point fwd TR:		***0,000 m***
Tow point below WL:		***0,000 m***

Propulsor data

Propulsor			
Count:		**1**	
Propulsor type:		**Propeller series**	
Propeller type:		**FPP**	
Propeller series:		**B Series**	
Propeller sizing:		**By thrust**	
Reference prop:			
Blade count:		**6**	
Expanded area ratio:		**0,5801**	**[Size]**
Propeller diameter:		**10130,0 mm**	**[Size]**
Propeller mean pitch:	[P/D 0,8282]	**8389,7 mm**	**[Size]**
Hub immersion:		**16870,0 mm**	

Engine/gear	
Drive line:	**Direct drive**
Gear input:	**No gearbox**
Engine data:	
Rated RPM:	**0 RPM**
Rated power:	**0,0 kW**
Primary fuel:	**Defined**
Secondary fuel:	**None**
Gear efficiency:	**1,000**
Load correction:	**Off**
Gear ratio:	**1,000**
Shaft efficiency:	**0,970**

Propeller options		
Oblique angle corr:	**Off**	
Shaft angle to WL:	**0,00 deg**	
Added rise of run:	**0,00 deg**	
Propeller cup:	**0,0 mm**	
KTKQ corrections:	**Custom**	
Scale correction:	**None**	
KT multiplier:	**1,000**	
KQ multiplier:	**1,000**	
Blade T/C [0.7R]:	**0,00**	
Roughness:	**0,00 mm**	
Cav breakdown:	**On**	

Design condition [By thrust]		
Max prop diam:	**10130,0 mm**	
Design speed:	**15,50 kt**	
Reference thrust:	**3389,53 kW**	
Design point:	**1,000**	
Reference RPM:	**100,0 RPM**	
Design point:	**1,000**	
Shaft RPM:	**64,5 RPM**	**[Size]**

Propulsion

23 nov 2020 08:00

HydroComp NavCad 2018

Project ID **Petrolero de crudo 275000 TPM**

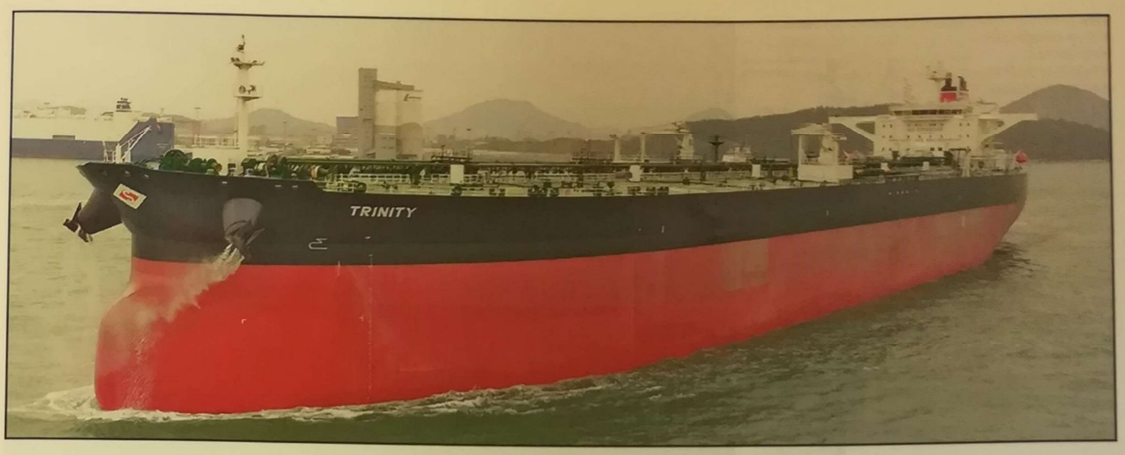
Description

File name **BUQUE PBAM I.hcnc**

Symbols and values

SPEED =	Vessel speed
PETOTAL =	Total vessel effective power
WFT =	Taylor wake fraction coefficient
THD =	Thrust deduction coefficient
EFFR =	Relative-rotative efficiency
RPMENG =	Engine RPM
PBENG =	Brake power per engine
VOLRATE =	Volumetric fuel rate total Primary
LOADENG =	Engine load as a percentage of engine rated power
RPMPROP =	Propulsor RPM
QPROP =	Propulsor open water torque
QENG =	Engine torque
PDPROP =	Delivered power per propulsor
PSPROP =	Shaft power per propulsor
PSTOTAL =	Total vessel shaft power
PBTOTAL =	Total vessel brake power
TRANSP =	Transport factor
EFFO =	Propulsor open-water efficiency
EFFG =	Gear efficiency (load corrected)
EFFOA =	Overall propulsion efficiency [=PETOTAL/PSTOTAL]
MERIT =	Propulsor merit coefficient
THRPROP =	Open-water thrust per propulsor
DELTHR =	Total vessel delivered thrust
J =	Propulsor advance coefficient
KT =	Propulsor thrust coefficient [horizontal, if in oblique flow]
KQ =	Propulsor torque coefficient
KT/J2 =	Propulsor thrust loading ratio
KQ/J3 =	Propulsor torque loading ratio
CTH =	Horizontal component of bare-hull resistance coefficient
CP =	Propulsor thrust loading coefficient
RNPROP =	Propeller Reynolds number at 0.7R
SIGMAV =	Cavitation number of propeller by vessel speed
SIGMAN =	Cavitation number of propeller by RPM
SIGMA07R =	Cavitation number of blade section at 0.7R
TIPSPEED =	Propeller circumferential tip speed
MINBAR =	Minimum expanded blade area ratio recommended by selected cavitation criteria
PRESS =	Average propeller loading pressure
CAVAVG =	Average predicted back cavitation percentage
CAVMAX =	Peak predicted back cavitation percentage [if in oblique flow]
PITCHFC =	Minimum recommended pitch to avoid face cavitation
+ =	Design speed indicator
* =	Exceeds recommended parameter limit
! =	Exceeds recommended cavitation criteria [warning]
!! =	Substantially exceeds recommended cavitation criteria [critical]
!!! =	Thrust breakdown is indicated [severe]
--- =	Insignificant or not applicable

15 ANEXO IV: BASE DE DATOS



TRINITY: 159,000dwt oil tanker

Shipbuilder: ..... **Hyundai Samho Heavy Industries Co. Ltd**
Vessel's name: ..... ***TRINITY***
Hull No: **S787**
Owner/Operator: ... **Diamond/Anglo Eastern Ship Management (S) Pte Ltd**
Country: ..... **USA**
Designer: ..... **Hyundai Samho Heavy Industries Co Ltd**
Country: ..... **Republic of Korea**
Model test establishment used: ..... **Hyundai Maritime Research Institute**
Flag: ..... **Marshall Islands**
IMO number: **9730361**
Total number of sister ships already completed (excluding ship presented): ..... **One**
Total number of sister ships still on order: .. **Two**

TRINITY features a number of innovations. These aim to deal with new environmental regulations set to come into force in the near future.

The 159,000dwt tanker has been fitted with a LNG duel fuel system with upper deck reinforcement and space reservation based on six LNG storage tanks. Energy saving devices include a pre-swirl duct, while a full spade rudder was fitted for increased manoeuvrability. The vessel performance is further enhanced with a Kyma ship performance system.

With the introduction of the Ballast Water Convention in 2007, the ship has been fitted with a Hi-ballast ballast water treatment system.

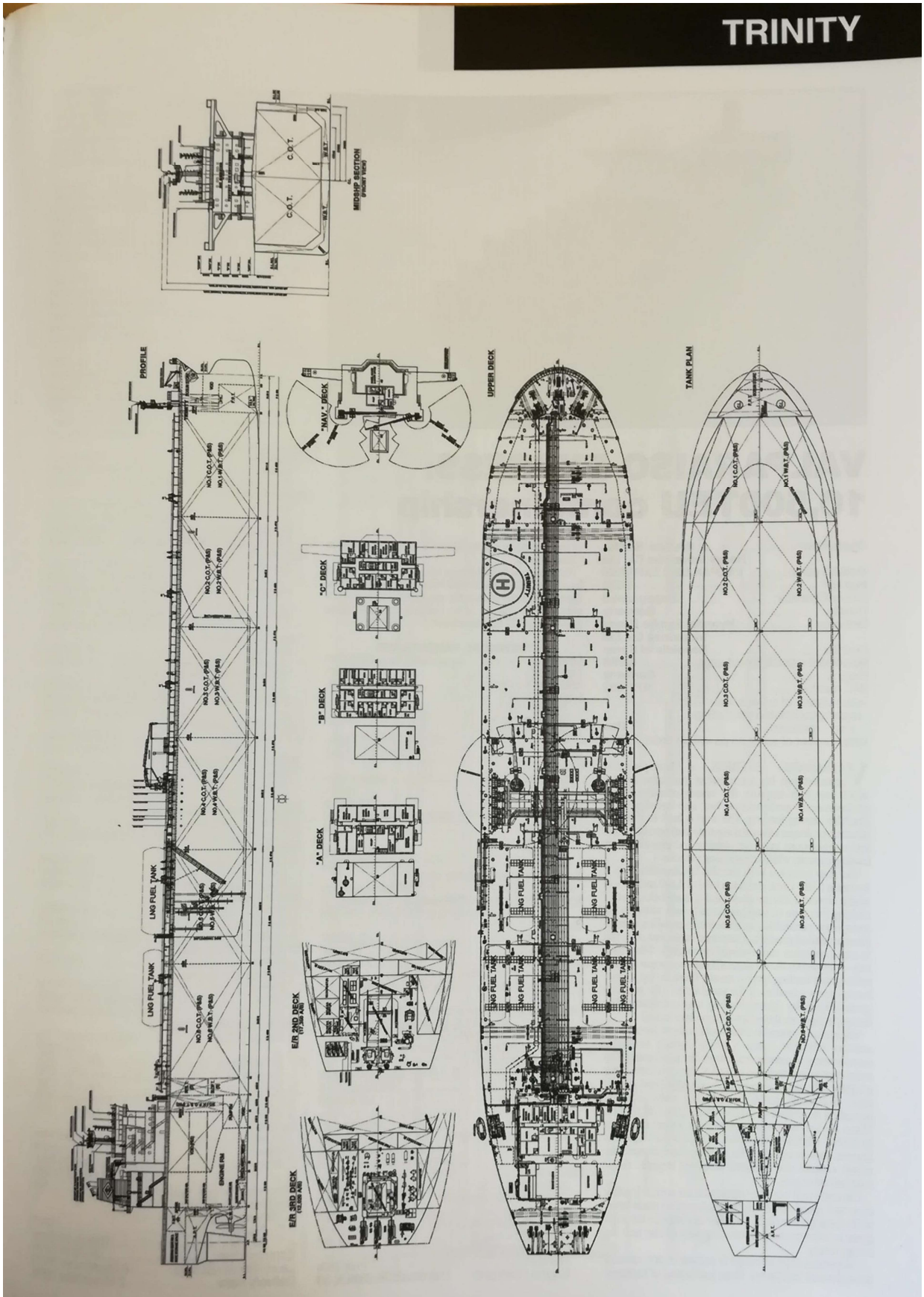
Security features include a citadel inside the steering gear room, and the vessel complies with the 2013 Vessel General Permit and is certified for operation through the new Panama transit scheme.

TECHNICAL PARTICULARS

Length oa: 274.17m
Length bp: 263.14m
Breadth moulded: 48m
Depth moulded
To main deck: 23.1m
To upper deck: 23.1m
Width of double skin
Side: 2.5m
Bottom: 2.7m
Draught
Scantling: 17.15m
Design: 16m
Gross: 81,360gt
Displacement: ..... 183,887tonnes (at scantling)
Lightweight: 25,153tonnes
Deadweight
Design: 145,118tonnes
Scantling: 158,734tonnes
Block co-efficient (please state relevant draught): ..... 0.8260 (at scantling)
Speed, service (-- %MCR output): ..... 14.2knots at scantling at NCR with 15%S.M.

Cargo capacity
Liquid volume: ..... 173,579m^3
Bunkers
Heavy oil: ..... 3,567.8m^3
Diesel oil: ..... 677.2m^3
Water ballast: ..... 52,924.9m^3
Tankers - percentage segregated ballast: 100%
Daily fuel consumption (tonnes/day)
Main engine only: ..... 165.4g/kWh + 5% at MCR
Classification society and notations: ..... ABS, +A1, (E), Oil Carrier, +AMS, +ACCU, CSR, AB-CM, ESP, UWILD, CPS, TCM, VEC, RW, SPMA, ENVIRO, CRC, PMA, RRDA.
Main engine(s)
Design: ..... Hyundai-MAN B&W
Model: 5G70ME-C9.2
Manufacturer: ..... HHI-EMD
Number: ..... One
Type of fuel: ..... HFO/MDO/MGO
Output of each engine: ..... 14,520kW x73.8rpm (Two stroke, Crosshead, Turbocharged)
Propeller(s)
Material: ..... Ni.Al.Bronze
Designer/Manufacturer: ..... HHI-EMD
Number: ..... One
Fixed/Controllable pitch: ..... Fixed pitch
Diameter: 8.8m
Diesel-driven alternators
Number: ..... Three sets
Engine make/type: ..... HHI-EMD/ HIMSEN 7H21/32
Type of fuel: ..... HFO/MDO/MGO
Output/speed of each set: ..... About 1,200kW@900rpm
Alternator make/type: ..... HHI-EMD/ Marine Design IP23 Enclosure brushless
Output/speed of each set: ..... About 1,120kW@900rpm
Boilers
Number: ..... 2 sets
Type: ..... Automatic, forced draft, Heavy Fuel Oil burning, marine boiler
Make: ..... KANG-RIM
Output, each boiler: ..... 35,000kg/h x 2 sets
Other cranes
Number: ..... Two sets
Make: ..... Oriental Precision & Engineering
Type: ..... Electro-hydraulic drive system
Tasks: ..... Hose handling crane
Performance: ..... 20tonnes x 10m/min
Other cranes
Number: ..... Two sets
Make: ..... Oriental Precision & Engineering
Type: ..... Electro-hydraulic drive system
Tasks: ..... Provision crane
Performance: ..... 2tonnes x 10m/Min, 8tonnes x 10m/Min
Mooring equipment
Number: ..... Nine sets
Make: ..... Pusnes/DMC
Type (electric/hydraulic/steam): ..... Hydraulic
Cargo tanks
Number: 15
Grades of cargo carried: ..... Crude oil
Product range: ..... Crude oil
Coated tanks – make and type of coating: ..... Cargo Oil Tanks, KCC, Epoxy x 2 coats (bottom and up to 300mm upward)
Cargo pumps
Number: ..... 3 sets
Type: ..... Steam turbine driven ver. Centrifugal single stage
Make: ..... Hyundai Heavy Industries
Capacity (each): ..... 4,000m^3/h x 135mTH
Cargo control system
Make: ..... HHI-EMD
Type: ..... Hydraulically operated and remotely controlled
Ballast control system
Make: ..... HHI-EMD
Type: ..... Hydraulically operated and remotely controlled
Water Ballast Treatment System
Make: ..... Hyundai Heavy Industries Co. Ltd
Capacity: ..... Electrolysis unit capacity: 4,000m^3/h + 300m^3/h(for A.P.T.)
Capacity: ..... Filter unit capacity: 2,500m^3/h x 2 + 250m^3/h (for A.P.T.)
Complement
Officers: ..... 12 persons
Crew: ..... 16 persons
Fire detection system
Make: ..... Consilium Marine AB
Fire extinguishing systems
Cargo holds: ..... Foam, sea water
Make/Type: ..... NK CO., LTD.
Engine room: ..... CO_2
Make/Type: ..... NK CO., LTD.
Cabins: ..... P.F.E., sea water
Make/Type: ..... NK CO., LTD.
Radars
Number: ..... Two sets
Make: ..... JRC
Model(s): ... S-BAND: JMR-9282-S, X-BAND: JMR-9225-6X
Integrated bridge system? ..... No
Waste disposal plant
Incinerator
Make: ..... Hyundai-Atlas
Model: .Sludge oil and solid waste burning
Sewage plant
Make: ..... Il Seung Co. Ltd
Model: ..... Biological type
Contract date: ..... 7 February 2014
Launch/float-out date: ..... 30 December 2015
Delivery date: ..... 29 March 2016

TRINITY


MIDSHIP SECTION
C.O.T.
C.O.T.
W.B.T.
PROFILE
LNG FUEL TANK
LNG FUEL TANK
"NAV." DECK
"C" DECK
"B" DECK
"A" DECK
E/R 2ND DECK
E/R 3RD DECK
UPPER DECK
TANK PLAN

PEGASUS VOYAGER: Crude oil tanker

Shipbuilder: **Samsung Heavy Industries**
Vessel's name: ***Pegasus Voyager***
Hull No: **HN2060**
Owner/operator: **Chevron**
Country: **USA**
Designer **Samsung Heavy Industries**
Country: **Korea**
Model test establishment used: **SSMB**
Flag: **Bahama's**
IMO number: **9665736**
Total number of sister ships already completed (excluding ship presented): **1**
Total number of sister ships still on order: **nil**

PEGASUS Voyager is the latest in a series of vessels for US-based Chevron and is the first vessel in a series of two which was delivered in August. The two vessels feature the latest environmental solutions to meet with stricter environmental legislation that is starting to come in to effect.

To meet with these further environmental demands the vessel's design employs some of the latest energy saving features currently on the market such as energy saving devices that have been installed to the aft body of the hull to enhance the vessel's power performance, along with a longer flat side hull form. Added to this is an exhaust gas recirculation system has also been installed onto the main engine to further improve the vessel's green profile.

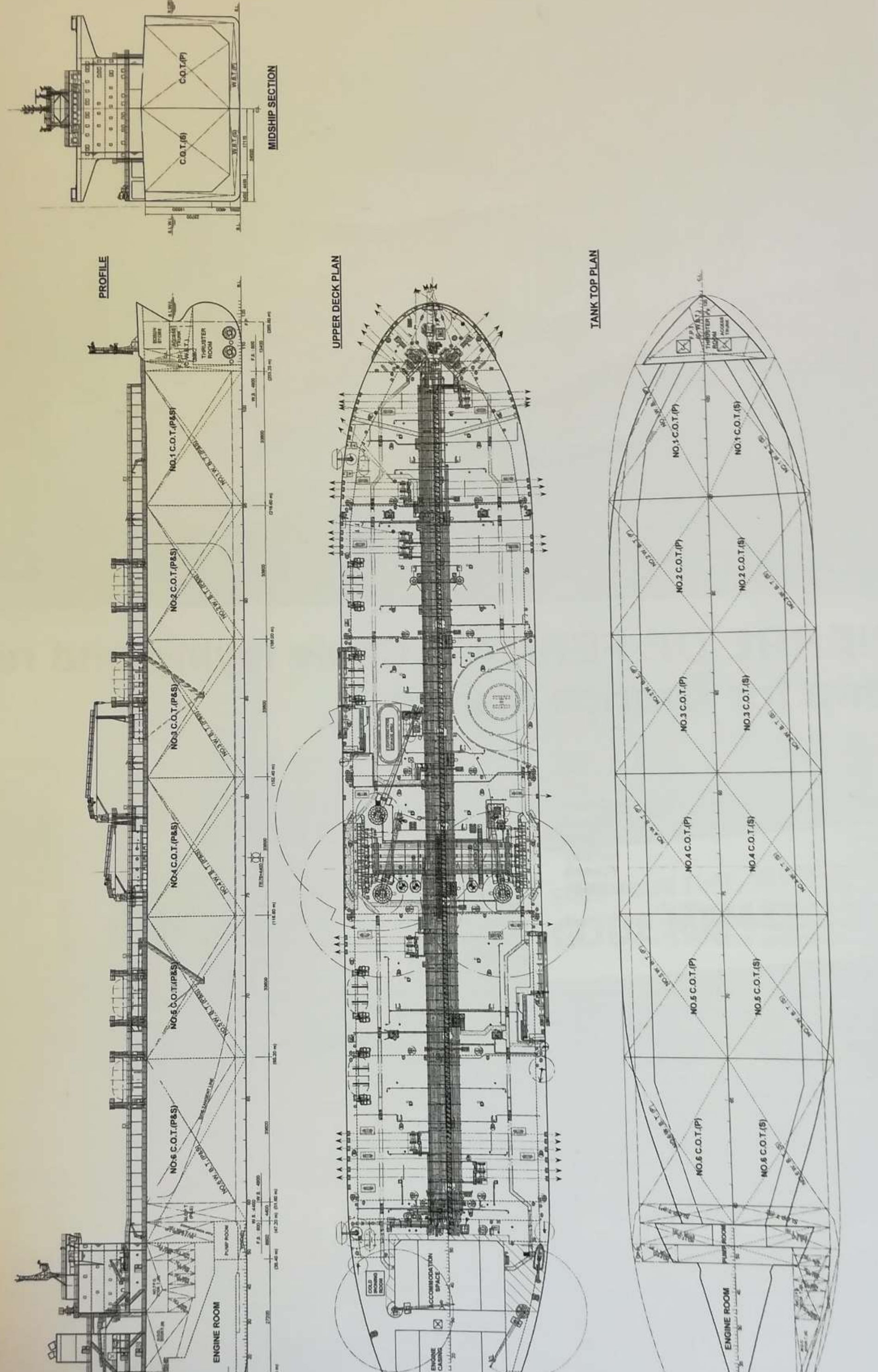
Pegasus Voyager has a cargo capacity of 178,600m^3 with a cargo handling system that has been designed to have a maximum unloading rate of 11,400m^3/h with three cargo oil pumps manufactured by the shipyard that have a capacity of 3,800m^3/h that service the 12 cargo tanks of the vessel.

The vessel is powered by a MAN B&W 6G70ME-C, along with three generator sets, one shaft generator and one steam turbine generator. To give the vessel better manoeuvrability it has been fitted with a controllable pitch propeller, high lift rudder, two bow thrusters, a fender and a second manifold for cargo handling.

TECHNICAL PARTICULARS

Length oa: 275.60m
Length bp: 265.60m
Breadth moulded: 48.00m
Depth moulded
To upper deck: 23.70m
Width of double skin
Side: 2.45m
Bottom: 2.55m
Draught
Scantling: 17.00m
Summer: 17.00m
Gross: 85,147gt

Deadweight
Summer: 155,720dwt
Scantling: 155,720dwt
Speed, service: 15knots
Cargo capacity
Liquid volume: 178,600m^3
Bunkers
Heavy oil: 3,400m^3
Diesel oil: 400m^3
Water ballast: 51,000m^3
Classification society and notations: ABS✠A1 (E), oil carrier, ESP, CSR, SH-DLA, SFA (25), RES, TCM, ✠AMS, CRC, ✠ACCU, UWILD, APS, Enviro+, ABCM, NIBS, PORT, POT, CPS, CPP, PMA+, SEC, VEC-L, GP, MLC-ACCOM, BWT
Main engine
Design: MAN B&W
Model: 6G70ME-C9.2
Manufacturer: Doosan Engine
Number: 1
Type of fuel: HFO or MDO
Output of each engine: 21,840kW/ 17,110kW/ 14,543kW
Propeller
Material: Ni-Al-Bronze
Designer/manufacturer: Kawasaki Heavy Industries
Number: 1
Fixed/controllable pitch: Fixed
Diameter: 8.4m
Main-engine driven alternators
Number: 1
Make/type: Doosan Engine/DIG 140 i/4 W
Output/speed of each set: 2,500kW
Diesel-driven alternators
Number: 4
Engine make/type: Doosan engine/ 6L21/31 x 2 + 8L27/38 x 1 set STX Engine/ KTA19-DMGE x 1 set
Type of fuel: HFO or MDO
Output/speed of each set: 1,160kW x 2 sets + 2,500kW x 1 set 400kW x 1 set
Alternator make/type: Hyundai Heavy Industries/ HFJ7 568-84E x 2 sets + HSJ 719-10P x 1 set
Output/speed of each set: 1,575kVA x 2 sets + 3,125kVA x 1 set
Boilers
Number: 5
Type: Mission OL50,000 x 2 sets, Mission XW-S 50,000 x 2 sets, Mission OC-TCI 3,600 x 1 set
Make: Alfa Laval
Output, each boiler: 50tonnes/h x 2 sets, 50tonnes/h x 2 sets, 3.6tonnes/h x 1set
Cargo cranes/cargo gear
Number/ Make: 3/TTS Marine
Type: Electro-hydraulic driven, High pressure type
Performance: 15tonnes x 20m x 2 sets, 8tonnes x 28m x 1 set
Other cranes
Number/ Make: 2 x provisions crane TTS Marine
Type: Electro-hydraulic driven, High pressure type
Performance: 10tonnes x 15.5m/ 5tonnes x 19m
Mooring equipment
Number: 2 x windlass + 12 mooring winches
Make: Rolls-Royce
Special lifesaving equipment
Number of each and capacity: x 50 persons
Number/ Make: Norsafe/Freefall type
Cargo tanks
Number: 12
Cargo pumps
Number/ Make: 3/Centrifugal type
Make: Hyundai Heavy Industries Co., Ltd
Capacity: 3,800m^3/h
Water ballast treatment system
Make: Oceansaver
Capacity: 2 x 2,500m^3/h
Stern appendages/ special rudders: SAVER-fin/flap rudder
Bow thruster
Make: Kawasaki
Number: 2
Output: 2,300kN
Bridge control system
Make: Kongsberg Maritime Korea
Type: K-Chief 600
Fire detection system
Make: Consilium Marine
Type: Analogue addressable type
Radars
Number/Make: 1/Sperry Marine
Integrated bridge system
Make/Model: Sperry Marine/Visionmaster
Contract date: 25 May 2012
Launch/float-out date: 5 April 2014
Delivery date: 5 August 2014


MIDSHIP SECTION
PROFILE
UPPER DECK PLAN
TANK TOP PLAN
NO.1 C.O.T.(P&S)
NO.2 C.O.T.(P&S)
NO.3 C.O.T.(P&S)
NO.4 C.O.T.(P&S)
NO.5 C.O.T.(P&S)
NO.6 C.O.T.(P&S)
ENGINE ROOM
PUMP ROOM
THRUSTER ROOM
ACCOMMODATION SPACE
ENGINE CASING
NO.1 C.O.T.(P)
NO.1 C.O.T.(S)
NO.2 C.O.T.(P)
NO.2 C.O.T.(S)
NO.3 C.O.T.(P)
NO.3 C.O.T.(S)
NO.4 C.O.T.(P)
NO.4 C.O.T.(S)
NO.5 C.O.T.(P)
NO.5 C.O.T.(S)
NO.6 C.O.T.(P)
NO.6 C.O.T.(S)
C.O.T.(P)
C.O.T.(S)

HUA YUN: Eco-friendly oil tanker

Shipbuilder: **CSBC Corporation, Taiwan Keelung shipyard**
Vessel's name: ***Hua Yun***
Hull number: **HNO981**
IMO number: **9566344**
Owner/Operator: **CPC Corporation, Taiwan**
Designer: **CSBC Corporation, Taiwan**
Model test establishment used: **HSVA, Germany**
Flag: **Republic of China**
Total number of sister ships already completed (excluding ship presented): **1**
Total number of sister ships still on order: **nil**

Hua Yun is the first oil tanker in a series of two that has been constructed to the common structural rules (CSR) and performance standard for protective coatings (PSPC) at CSBC for ship owner, CPC Corporation, Taiwan. The principle of this modern vessel is to provide oil transportation around the island of Taiwan.

Due to this operational need, the ship owner has been involved in some design aspects and a lot of the discussions with the yard during the design's progress and construction stage.

Corrugated bulkheads with upper stool and lower stool have been adopted in the cargo oil tanks for easy tank cleaning and reducing residual oil during unloading of cargo oil. Both cargo oil tanks and fuel oil tanks are protected by the double hull structure.

No.4 cargo oil tanks can be used as water ballast tanks in emergencies but, the water ballast amount is enough for a heavy weather ballast voyage even though No.4 cargo oil tanks many not be utilised.

The model testing at HSVA, Germany gave the ship speed performance of the final hull form design, which was better than the ship owner's requirement.

The vessel is fitted with a Wärtsilä 6RT-flex50-B main engine, which develops 9960kW (MCR) at 124rpm and service speed at design draught can achieve 15.51knots according to the sea trial result. This type of engine is equipped with a common rail system for a fuel oil and servo oil system and with a pulse lubricator for cylinder oil system, which gives better fuel oil and cylinder oil consumption efficiency, respectively. The advanced MAPEX-PR system can detect the cylinder wall temperature and wear down for continuous monitoring of the piston-running behavior and will give a warning alarm if adverse conditions occur. Both the diesel main engine and generator meet the MARPOL NO_x Tier II requirement.

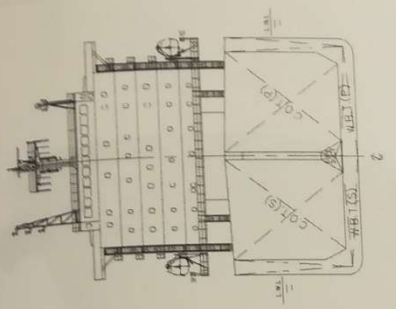
In order to comply with the PSPC requirement, the design and building process were adjusted accordingly. Including block arrangement, fitting design and installation, painting schedule, welding prevention, etc., all efforts to ensure the coating performance can satisfy the ship owner and class surveyor's strict supervision.

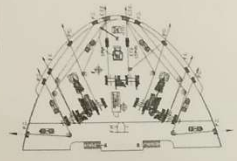
One of the unique achievements of the vessel is that the design and construction comply with BV's "CLEANSHIP 7+" notation. This vessel complies with, the latest environment protection requirements and no substances were discharged into the sea during seven consecutive days. In Europe, more and more ship owners and yards are pursuing this high standard, and in Asia, *Hua Yun* is the first vessel to have this notation. Although the ballast water management convention has not come into effect yet, an ozone type ballast water treatment system has been installed for ocean ecology protection.

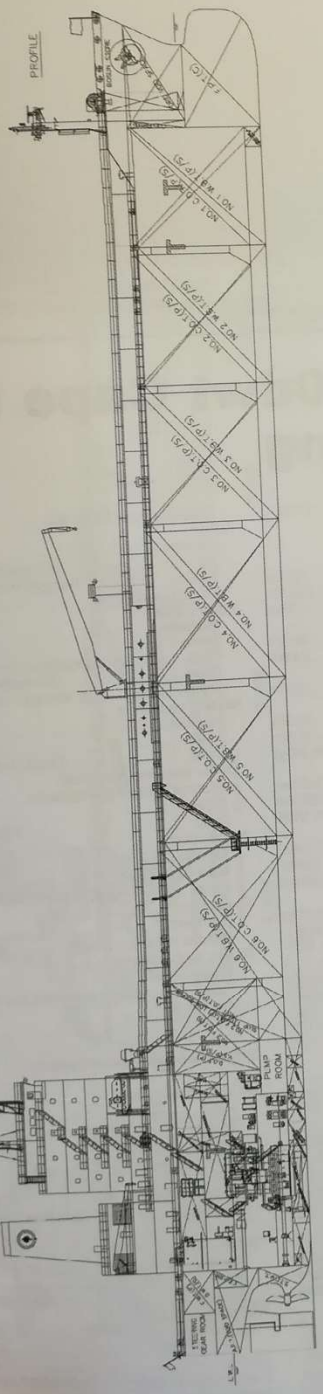
TECHNICAL PARTICULARS

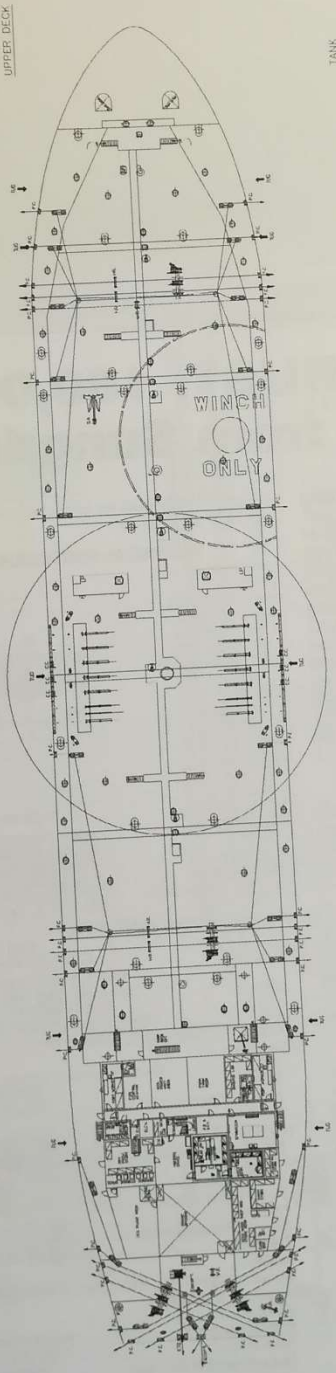
Length, oa: 182.00m
Length, bp: 174.00m
Breadth, moulded: 32.20m
Depth, moulded: 17.30m
Gross tonnage: 28,410gt
Draught
  Design: 11.00m
  Deadweight
  Design: 40,522dwt
Speed, at 90%MCR, 15% sea margin, design draught: 15.51 knots
Cargo capacity
Liquid volume: 46,518m^3
Bunkers
Heavy oil: 1513m^3
Diesel oil: 189m^3
Water ballast: 18,967m^3
Fuel consumption
  main engine only: 36.7tonnes/day
Classification society and notations: CR: 100+E, Oil Tanker, CMS(CAU)+BV: I +Hull +Mach Oil Tanker, CSR, CPS(WBT), ESP, +AUT-UMS, VCS, Unrestricted navigation, CARGOCONTROL , MON-SHAFT, INWATERSURVEY, CLEANSHIP 7+
Main engine
  Design: Wärtsilä
  Model: 6RT-flex50-B
  Manufacturer: Hyundai
  Number: 1
  Type of fuel: HFO/MDO
  Output(MCR): 9960kW x 124rpm
Propeller
  Material: Ni-Al-bronze
  Design/Manufacturer: CSBC/Hyundai
  Number: 1
  Pitch: Fixed
  Diameter: 5.8m
  Speed: 124rpm
Diesel-driven alternators
  Number: 4
  Type of fuel: HFO/MDO
  Engine make/type: Hyundai/HiMSEN7H17/28
  Alternator make/type: HHI-EES/HFC7 504-84K-EH
  Output: 770kW x 900rpm
Boilers
  Number: 1
  Type: MISSION OM vertical oil fired
  Make: AALBORG INDUSTRIES K.K.
  Capacity: 18000kg/h
Cargo crane
  Number: 1
  Make: DongNam Marine Crane
  Type: Electro-hydraulic
  Capacity: SWL 10tonnes x 22m
Mooring equipment
Number: 2 x mooring winch/windlass 5 x mooring winch
  Make: FLUTEK
  Type: Electro-hydraulic
Lifesaving equipment
  Number of each and capacity: 2 x 32 persons
  Make: JiangYinShi BeiHai Lsa
  Type: Gravity type
Cargo tanks
  Number: 12 + 2 slop tanks
  Grade: Crude oil/petroleum product
Cargo pumps
  Number: 3
  Type: Axially centrifugal single stage
  Make: Hamworthy
  Capacity: 1000m^3/h x 125m
Cargo/ballast control systems
  Make: Hamworthy
Ballast water treatment
  Type: Ozone
  Make: NK
Complement
  Officers: 13
  Crew: 17
  Single rooms: 30
Bridge control system
  Make: NABTESCO
  Type: M-800III
Fire detection system
  Make: Consilium Marine
  Type: SALWICO CS4000
Fire extinguishing system
  Engine room: Fixed CO_2
  Make:
Radars
  Number: 3
  Make: JRC
  Model: JMA-9133-SA/JMA-912 9123-7XA JMA-9122-6XA
Waste disposal plant
  Incinerator: KangRim/KFB-50
  Sewage plant: Sasakura/SD-3R
Contract date: 8 July 2009
Launch date: 30 November 2010
Delivery date: 8 April 2011

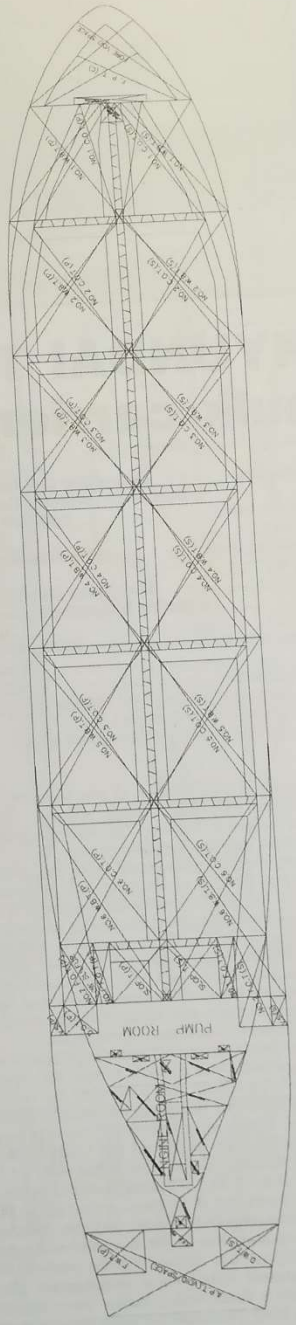
HUA YUN




PILE DECK


PROFILE
PUMP ROOM


UPPER DECK
WINCH
ONLY


TANK
PUMP ROOM

MAERSK SARA: Energy efficient VLCC

Shipbuilder:	STX Offshore & Shipbuilding Co., Ltd
Vessel's name:	*Maersk Sara*
Hull No:	S-1407
Owner/Operator:	A.P Møller-Maersk A/S
Country:	Denmark
Designer:	STX offshore & Shipbuilding Co., Ltd
Country:	Korea
Flag:	Singapore
IMO number:	9537745
Total number of sister ships already completed (excluding ship presented):	1
Total number of sister ships still on order:	2

Maersk Sara is a very large crude carrier (VLCC) that was delivered from STX offshore & Shipbuilding to A.P Møller-Maersk in May. The vessel's design was intended to reduce waste energy and emissions and it has been fitted with the latest in energy saving features.

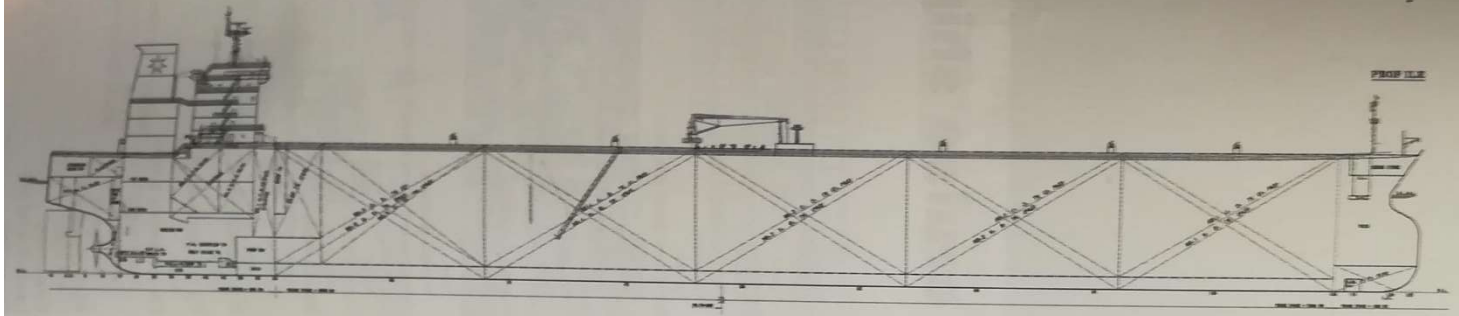
The vessel is designed as an ocean-going crude oil tanker driven by a single screw diesel engine. Accommodation including navigation bridge and engine room are located aft of the vessel, with the cargo area consisting of triple cargo oil tanks (port, starboard and centre) divided by bulkheads (port, starboard and centre) and one pair of slop tanks (port & starboard) with double bottom and double hull. The vessel has 15 cargo tanks and two slop tanks with a total capacity of approximately 352,834m³. The aft body with transom stern is used as a steering gear compartment, fresh water tanks and aft peak tank. Fore body with bulbous bow is used for fore peak tanks, chain lockers, void space and bosun store.

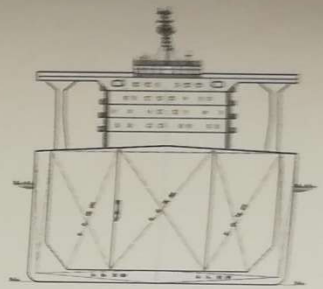
The vessel is designed to heighten energy efficiency by applying a Wide Chord Tip and Waste Heat Recovery System (WHRS), which switches heat of emission gas from the diesel engine to electric power. The Wide Chord Tip reduces noise and vibration and improves the propulsion efficiency. The WHRS can reuse not only waste heat from the engine but also steam from the boilers which offers a 7% decrease in carbon dioxide, so the Energy Efficiency Design Index (EEDI) can be reduced with around 5% fuel savings. At 15knots, the vessel has a fuel consumption of 94tonnes/day including the reduction achieved by the WHRS. In addition the vessel has the latest generation of electronically controlled diesel engines, enabling more efficient fuel consumption at varying speeds (more than 1% fuel consumption reduction).

An innovative lifeboat drop-in ball release system developed by Nadiro with A.P Møller-Maersk is fitted to the lifeboats. The system is designed as an off-load system with a hydraulic on-load functionality in emergencies with a locking pawl that prevents the ball from falling out of the housing.

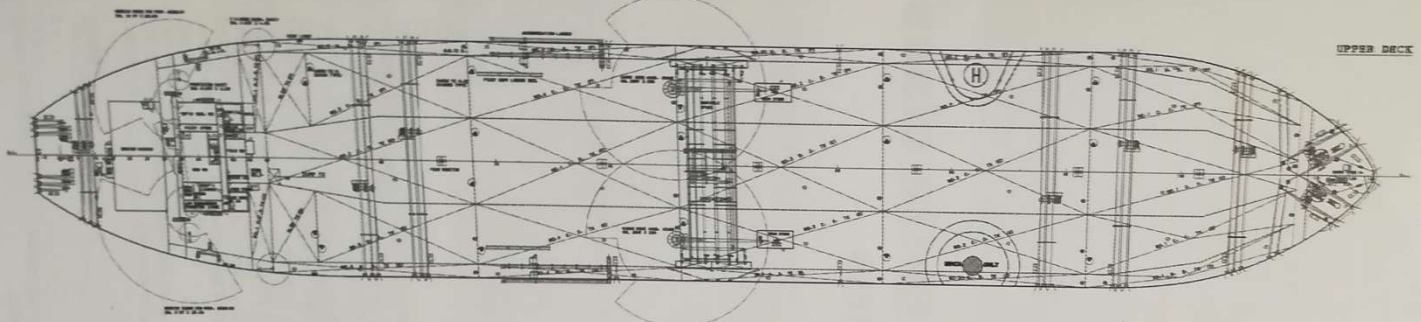
TECHNICAL PARTICULARS

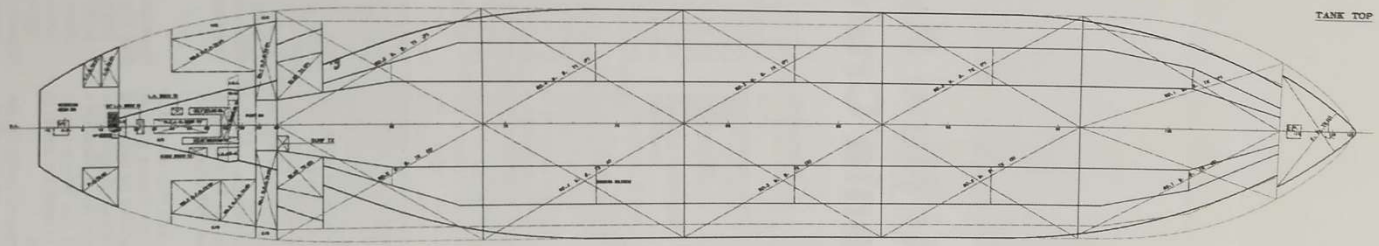
Length oa:	332m
Length bp:	319m
Breadth moulded:	60m
Depth moulded	
To upper deck:	30.5m
Draught	
Scantling:	22.60m
Design:	21m
Gross:	523.698tonnes
Displacement:	368.262tonnes
Lightweight:	450.72tonnes
Deadweight	
Design:	294.282dwt
Scantling:	323.190dwt
Block co-efficient:	0.8290
Speed, service:	16.28knots @ 90% MCR
Cargo capacity	
Liquid volume:	352.833m³
Bunkers	
Heavy oil:	8450m³
Diesel oil:	566m³
Water ballast:	102.176m³
Daily fuel consumption	
Main engine only:	104tonnes/day
Auxiliaries:	5.2tonnes/day
Classification society and notations:	LR +100 A1 Double Hull Oil Tanker, ESP, CSR, ShipRight (CM, ACS(B), FDA), LI, *IWS, +LMC, UMS, IGS, SPM, NAV1, with descriptive notes "Pt.Ht., ShipRight (BWMP (S), SCM)"
% high-tensile steel used in construction:	55%
Main engine	
Design:	MAN Diesel & Turbo
Model:	6S90ME-C (Mark 8)
Manufacturer:	STX Heavy Industries
Number:	1
Type of fuel:	HFO, MDO
Output of each engine:	29,340kW x 74rpm
Propeller	
Material:	G-Cu A110 Ni F650
Designer/Manufacturer:	MMG
Number:	1
Fixed/controllable pitch:	Fixed
Diameter:	9.8m
Speed:	76rpm
Diesel-driven alternators	
Number:	2
Engine make/type:	STX-MAN Holeby/ 6L21/31
Type of fuel:	HFO, MDO
Output/spedd of each set:	1320kW x 900rpm
Alternator make/type:	Hyundai/ HFJ7 568-84K
Output/speed of each set:	1252kW x 900rpm
Auxiliary boilers	
Number:	2
Type:	Oil fired with superheated section
Make:	Mitsubishi Heavy Industries, Ltd
Output, each boiler:	45tonnes/h
Exhaust gas boiler	
Number:	2
Type:	Dual pressure
Make:	Aalborg
Output, each boiler:	6.44tonne/h (superheated steam) 1.3tonnes/h (Saturated steam)
Cargo cranes/cargo gear	
Number:	2
Make:	DMC
Type:	Electric-hydraulic cylinder luffing single jib type
Performance:	SWL 20tonnes
Provision cranes	
Number:	2
Make:	DMC
Type:	Electric-hydraulic driven cylinder luffing single jib type
Tasks:	Provsions & engine parts handling
Performance:	SWL 10tonnes (port) 3tonnes (stb'd)
Mooring equipment	
Number:	10
Make:	TTS Kocks
Type:	Hydraulic
Special lifesaving equipment	
Number of each and capacity:	2 x 30 persons
Make:	Fassmer
Type:	Gravity
Cargo tanks	
Number:	5 cargo tanks (P,C,S) 1 slop tank (P,S)
Grades of cargo carried:	Crude oil having a flash point below 60°C
Coated tanks make and type of coating:	Hempel/ epoxy coating
Cargo pumps	
Number:	3
Type:	Centrifugal, steam turbine driven
Make:	Shinko
Capacity:	5500m³/h x 150mth
Cargo control system	
Make:	Emerson(VRC), Shinko
Type:	Remote control
Ballast control system	
Make:	Emerson(VRC), Shinko
Type:	Remote control
Complement	
Officers:	14
Crew:	10
Fire detection system	
Make:	Consilium
Type:	Analogue addressable fire alarm system
Fire extinguishing systems	
Cargo holds:	Deck foam/ Danfoss-semco/ protein foam
Engine room:	CO_2/ Danfoss-semco
Radars	
Number:	3
Make:	JRC
Models:	JMA-9132-SA, JMA-9122-9XA, JMA-5132-6HS
Integrated bridge system	
Make:	JRC
Model:	JAN-2000-CON
Waste disposal plant	
Incinerator:	Hyundai-Atlas/ Maxi 1500SL WS
Contract date:	
Launch/float-out date:	8 September 2008





MIDSHIP SECTION





ASTIR LADY: Oil tanker from SPP Shipbuilding

Shipbuilder:	SPP Shipbuilding Co.,Ltd
Vessel's name:	*Astir Lady*
Hull No:	S-5050
Owner/operator:	Western Shipping
Country:	Singapore
Designer:	SPP Shipbuilding Co., Ltd
Country:	Korea
Flag:	Singapore
IMO number:	9457385
Total number of sister ships already completed (excluding ship presented):	nil
Total number of sister ships still on order:	nil

Astir Lady is a one off oil tanker design that was constructed for global operator Western Shipping by SPP Shipbuilding Co. Ltd, which was delivered to the owner in April. The vessel is a 50,000dwt oil/chemical tanker, which has been fully designed by SPP and registered under the Singapore flag and classed by ABS. The vessel design incorporates the knowledge that SPP has gained through other vessel designs.

The vessel has a bulbous bow, transom stern and a continuous deck that includes the forecastle. The cargo areas have three longitudinal bulkheads with a double bottom and double hull, and consist of six pairs of cargo oil tanks, one pair of slop tanks, residue tank and six pairs of water ballast tanks. All fuel oil tanks are of double skin and fully comply with the MARPOL 12A regulation for fuel oil tanks protection. The vessel also has a five-tiered deckhouse for complying with the SOLAS visibility regulation and provides accommodation for a complement of 26 persons excluding the Suez crew. The vessel also has two Norsafe lifeboats installed that each have a capacity for 26 persons.

Astir Lady's hull has been optimised with the design focusing on tidal current effects of the hull; because of this the speed of vessel can be higher than other vessels of its type. The main engine, a MAN B&W Licensee 6S50MC-C (MK VII) built by DOOSAN, produces 7013kW for service speed of 15.3knots when running at 85% a MCR power of main engine with a 15% sea margin.

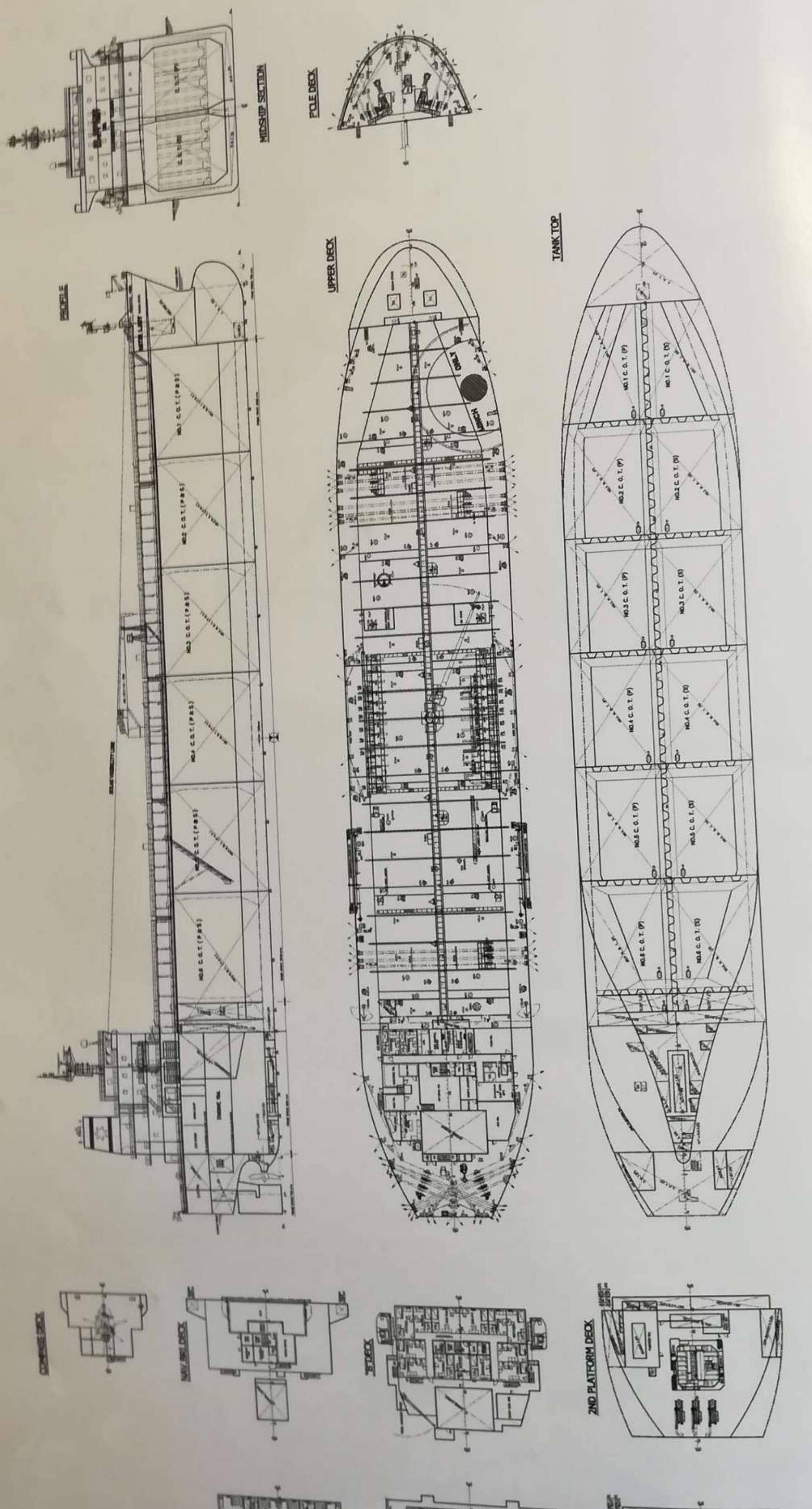
Astir Lady is constructed as a crude/product oil tanker and has a capacity of 54,602m^3, with the capacity of 1500m^3 for the fuel oil, the cruising range is about 11,500 nautical miles on the basis of speed of 15knots considering three reserve days. The vessel has been designed and constructed to be loaded with type 2k & 3 cargoes of Ch.17, International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk (IBC) code and cargoes for pollution category Z and OS of Ch.18, IBC Code. These products include oil products, molasses, CBFS, caustic soda, and crude oil. The heavy fuel oil tanks are protected by the void space. The vessel is fitted with 12 Framo submerged cargo pumps that have a capacity of 600m^3 x 125ml, with a further two pumps that have a capacity of 300m^3 x 125ml in the slop tanks and a pump in the residual tank.

The cargo tank coating material is not pure epoxy, but phenolic epoxy and cargo pumps are of the hydraulically motor driven, submerged type. Therefore, this vessel is expected to transport a greater variety of cargoes and can perform at more efficient loading / discharging rate compared with other similar types vessels.

TECHNICAL PARTICULARS

Length oa:	183.00m
Length bp:	174.00m
Breadth moulded	
To upper deck:	19.10m
Width of double skin	
Side:	2.00m
Bottom:	2.15m
Draught	
Scantling:	13.06m
Design:	11.00m
Gross:	30,043gt
Deadweight	
Design:	39,659dwt
Scantling:	50,285dwt
Speed, service:	15.29knots @ 85% MCR with 15% sea margin
Cargo capacity	
Liquid volume:	54,602m^3
Bunkers	
Heavy oil:	1337m^3
Gas oil:	174m^3
Water ballast:	23,092m^3
wClassification society and notations:	ABS +A1, E, Oil Chemical carrier Ship type 3, +AMS, +ACCU, CSR, AB-CM, VEC-L, RES, ESP, UMILD, TCM, CPP, CPS, CRC.
Main engines	
Design:	MAN DIESEL
Model:	6S50MC-C7
Manufacturer:	Doosan Engine
Number:	1
Type of fuel:	HFO
Output of each engine:	9480kW x 127rpm
Propeller	
Material	Ni-Al-Bronze
Designer/Manufacturer:	Sil La Metal/ Si La Metal
Number:	1
Fixed/controllable pitch:	Fixed
Diameter:	6m
Speed:	127rpm
Diesel-driven alternators	
Number:	3
Engine make/type:	Yanmar Diesel/6N21AL-EV
Type of fuel:	HFO
Output/speed of each set:	970kW x 900rpm
Alternator make/type:	Taiyo/GE 45C-8
Output/speed of each set:	1125KVA x 900rpm
Boilers	
Number:	1
Type:	Mission oil boiler
Make:	Aalborg Industries
Output, each boiler:	18,000kg/h x 7kg/cm^2
Cargo cranes/cargo gear	
Number:	1
Make:	Haean Machinery
Type:	Electric Hydraulic
Performance:	10tonne SWL, working radius 8m-2.8m
Mooring equipment	
Number:	7
Make:	Rolls-Royce
Type:	Hydraulic
Special life saving equipment	
Number of each and capacity:	2 x 26 persons
Make:	Norsafe
Type:	Totally enclosed lifeboat
Cargo tanks	
Number:	12 cargo tanks (No1 – No6(P&S)), 2 slop tanks(P&S), 1 residual tank(P)
Product range:	Product oil/ chemical tanker
Cargo pumps	
Number:	12
Type:	Submerged
Make:	Framo
Capacity:	600m^3 x 125mlc (cargo pumps, 12 each) 300m^3 x 125mlc (slop cargo pumps (P&S), 2 each) 300m^3 x 125mlc (residual pump (P), 1 each)
Cargo control system	
Make:	Framo
Type:	Hydraulic power pack unit
Ballast control system	
Make:	Framo
Type:	Submerged pump
Complement	
Officers:	12 persons
Crew:	14 persons
Stern appendages/special rudders:	Semi-spade rudder
Fire detection system	
Make:	Consilium Marine AB
Type:	CS4000
Fire extinguishing systems	
Cargo holds: NK/ Foam system	
Engine room:	NK/CO_2 system
Contract date:	December 2006
Launch/float-out date:	November 2010
Delivery date:	April 2011

ASTIR LADY


PROFILE
MIDSHIP SECTION
POLE DECK
UPPER DECK
TANK TOP
2ND PLATFORM DECK
1ST PLATFORM DECK

GENER8 HECTOR: 300,000dwt crude oil tanker

Shipbuilder:	**Hanjin Heavy Industry & Construction Co. Ltd.**
Vessel's name:	***GENER8 HECTOR***
Hull No:	**NTP0137**
Owner/Operator:	**Navig8 Tankers**
Country:	**Singapore**
Designer:	**Hanjin Heavy Industry & Construction Co. Ltd.**
Country:	**Republic of Korea**
Model test establishment used:	**KRISO**
Flag:	**LIBERIA**
IMO number:	**9730086**
Total number of sister ships already completed (excluding ship presented):	**0**
Total number of sister ships still on order:	**4**

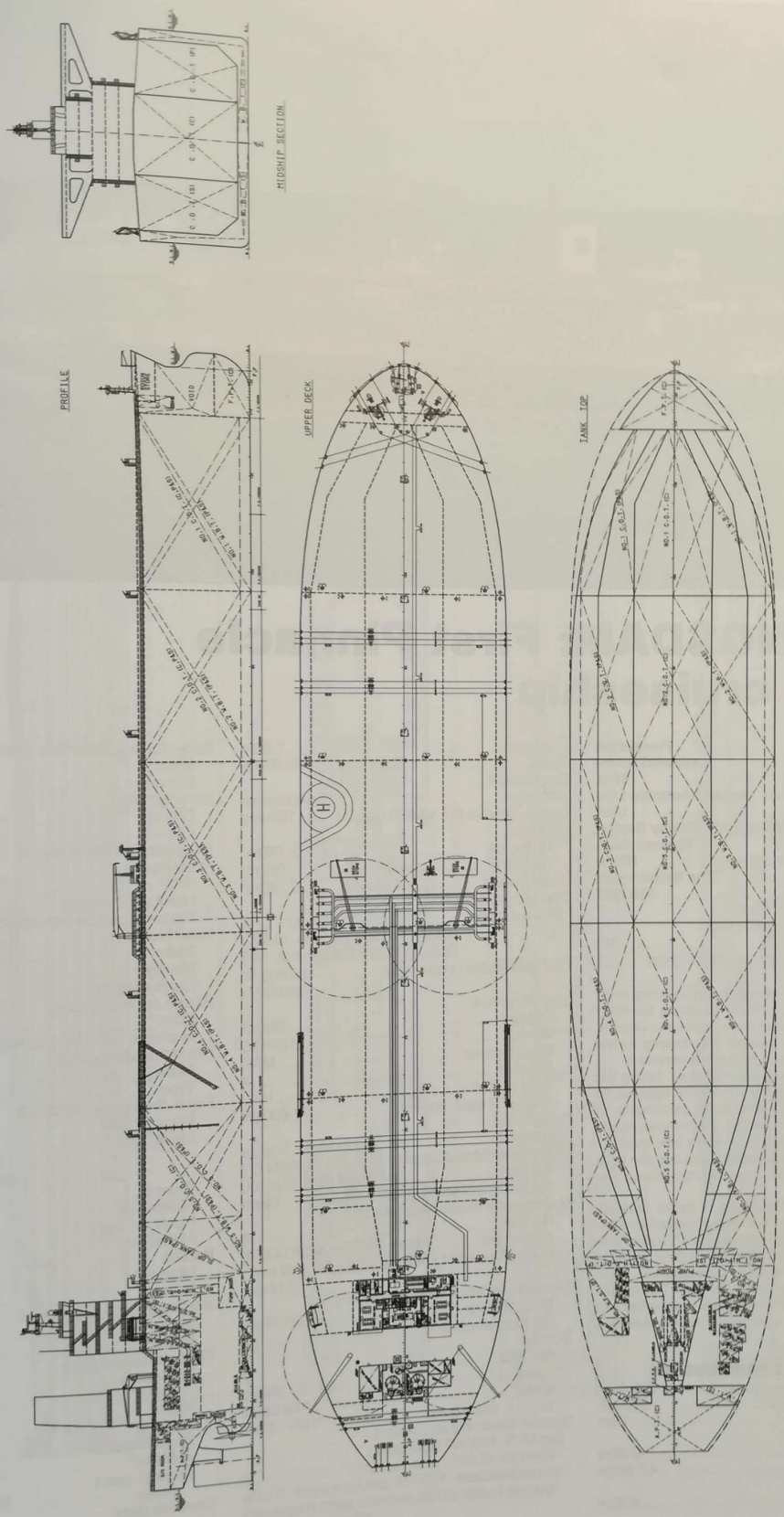
GENER8 HECTOR is the first VLCC designed by Hanjin Heavy Industries in Korea and built at Hanjin Subic Shipyard in the Philippines. It is an ocean-going 300,000dwt crude oil tanker with a double bottom and double-hull structure of cargo tanks that consists of five pairs of centre, port and starboard cargo tanks, two slop tanks and five pairs of water ballast tanks surrounding the cargo tanks. The fuel oil tanks are also protected by the double-hulled structure in accordance with the International Maritime Organization (IMO) fuel oil protection requirements.

Gener8 Hector is powered by a MAN 7G80ME-C9.2 main engine which produces a SMCR of 26,460kW at 66 rpm to give the vessel a service speed of 14.8 knots at NCR with 15% sea margin on 20.5 m draft.

The hull form of *Gener8 Hector* is optimised to achieve a higher propulsive efficiency with a MEWIS duct and a rudder bulb deployed as energy saving devices in order to have competitive fuel oil consumption. The hull structures are designed in accordance with the International Association of Classification Societies (IACS) common structural rules (CSR), based on a 25 year service life in North Atlantic wave conditions.

TECHNICAL PARTICULARS

Length oa:	333m
Length bp:	321.9m
Breadth moulded:	60m
Depth moulded	
To main deck:	29.5m
To upper deck:	29.5m
Width of double skin	
Side:	3m
Bottom:	3m
Draught	
Scantling:	21.6m (moulded)
Design:	20.5m (moulded)
Gross:	156,517tonnes
Displacement:	343,838.9tonnes
Lightweight:	abt. 45,400tonnes
Deadweight	
Design:	278,731.5tonnes
Scantling:	298,438.9tonnes
Block co-efficient:	0.797 (Design draught)
Speed, service (65 % SMCR output):	abt. 14.8knots
Cargo capacity	
Liquid volume:	344,826.44m^3
Bunkers	
Heavy oil:	5567.54m^3
Marine gas oil:	1041.35m^3
Water ballast:	91478.28m^3
Tankers - percentage segregated ballast:	100%
Daily fuel consumption	
Main engine only:	67.58tonnes/day
Auxiliaries (G/E):	5.7tonnes/day
Auxiliaries (Boiler):	70.9tonnes/day
Classification society and notations:	DNV, +1A1, "Tanker for Oil ESP", E0, CSR, SPM, BIS, VCS-2, BWM-T, COAT-PSPC(B;C), TMON, CLEAN, RECYCLABLE ERS (Emergency Response Scheme) shall be prepared by the buyer. The necessary information shall be provided by the builder upon the buyer's request.
% high-tensile steel used in construction:	abt.50%
Roll-stabilisation equipment:	Bilge keel
Main engine(s)	
Design:	MAN B&W
Model:	7G80ME-C9.2
Manufacturer:	Hyundai Heavy Industries
Number:	1 set
Type of fuel:	HFO or MGO
Output of each engine:	17,200kw x 57.2rpm (65% SMCR)
Propeller(s)	
Material:	NI. AL. Bronze
Designer/Manufacturer:	Hanjin Heavy Industry & Construction Co. Ltd. /Hyundai Heavy Industries
Number:	1
Fixed/Controllable pitch:	Fixed pitch
Diameter:	10.70m
Speed:	72rpm
Diesel-driven alternators	
Number:	3 sets
Engine make/type:	HYUNDAI HIMSEN 6H21/32M
Type of fuel:	HFO or MGO
Output/speed of each set:	1,263kw x 900rpm
Alternator make/type:	HHI-EES, HFC7 568-08P
Output/speed of each set:	1,200kw x 900rpm
Boilers	
Number:	Auxiliary boiler (2sets), M/E EGE (1set), G/E EGE (2sets)
Type:	PB type, Vertical cylindrical casing, pin tube, top mounting burner
Make:	KANGRIM
Output, each boiler:	Auxiliary boiler (40,000kg/h), M/E EGE (1,500kg/h), G/E EGE(250kg/h)
Cargo cranes/cargo gear	
Number:	2 sets
Make:	ORIENTAL
Type:	Electro-hydraulic driven, cylinder luffing type jib crane
Performance:	SWL 20tonnes
Other cranes	
Number:	2 sets
Make:	ORIENTAL
Type:	Electro-hydraulic driven, cylinder luffing type jib crane
Tasks:	Provision and engine part handling
Performance:	SWL 10tonnes / SWL 3tonnes
Mooring equipment	
Number:	10 sets
Make:	FLUTEK
Type (electric/hydraulic/steam):	Electro-Hydraulic type
Special lifesaving equipment (eg MES, free-fall lifeboats)	
Number of each and capacity:	2 x 28 persons
Make:	Hyundai Lifeboats
Type:	Hinged gravity type
Cargo pumps	
Number:	Three
Type:	Vertical, centrifugal, single stage, double suction type
Make:	Hyundai Heavy Industries
Stainless steel:	Shaft
Capacity (each):	5,000m^3/h x 150mTH at S.G. 1.025 and vis. 1 cSt
Cargo control system	
Make:	Hyundai Heavy Industries
Type:	Steam turbine
Ballast control system	
Make:	Ace Valve
Type:	Electro-hydraulic type
Water Ballast Treatment System	
Make:	Samsung Heavy Industries
Capacity:	6,000m^3/h (Elec. Type)
Complement	
Officers:	14
Crew:	14
Suez/Repair Crew:	6
Single/double/other rooms:	24/4/1
Bridge control system	
Make:	Hyundai Heavy Industries
Type:	X
Is bridge fitted for one-man operation?	No
Fire detection system	
Make:	Autronica
Type:	AutroSafe
Fire extinguishing systems	
Engine room:	CO_2
Make/Type:	FAIN/Fixed CO_2 Fire Extinguishing System
Radars	
Number:	2 sets
Make:	JRC
Model(s):	JMR-9230-S, JMR-9225-9X
Integrated bridge system?	Yes
Make:	Totem plus
Model:	CRN-45
Waste disposal plant	
Waste handled:	Partially handled
Incinerator	
Make:	Kangrim
Model:	KFB-110S
Waste compactor	
Make:	USON MARINE
Model:	UBP-30S
Sewage plant	
Make:	IL Seung
Model:	ISS-35N
Contract date:	25 March 2014
Launch/float-out date:	23 May 2016
Delivery date:	15 December 2016


MIDSHIP SECTION
PROFILE
UPPER DECK
TANK TOP

MILOS: Suezmax oil tanker

Shipbuilder: ..... **Sungdong Shipbuilding & Marine Engineering**
Vessel's name: ..... ***MILOS***
Hull No: **S2046**
Owner/Operator: ..... **Kyklades Maritime**
Country: ..... **Greece**
Designer: ..... **Sungdong Shipbuilding & Marine Engineering**
Country: ..... **Republic of Korea**
Model test establishment used: ..... **KRISO**
Flag: ..... **Greece, Piraeus**
IMO number: **9746619**
Total number of sister ships already completed (excluding ship presented): **0**
Total number of sister ships still on order: **1**

MILOS is the first vessel in a series of two Suezmax crude oil tankers, built by Sungdong Shipbuilding & Marine Engineering for Kyklades Maritime Corporation. The vessel is built to Lloyd's Register specifications and designed in accordance with IACS Common Structural Rules (CSR). The vessel features a double side skin and has a flush deck, bulbous bow, transom stern, open water type stern frame, semi-balanced rudder and single propeller driven by a slow speed diesel engine. The main engine MCR of its Wärtsilä 6X72 with delta by-pass tuning Tier II is de-rated to 15,088kW at 71.8rpm for economical fuel oil consumption. The speed of the vessel at design draught (16m) is 14.2knots at NCR with a 15% sea margin based on a well optimised hull form and propeller design that had been analysed by Computational Fluid Dynamics.

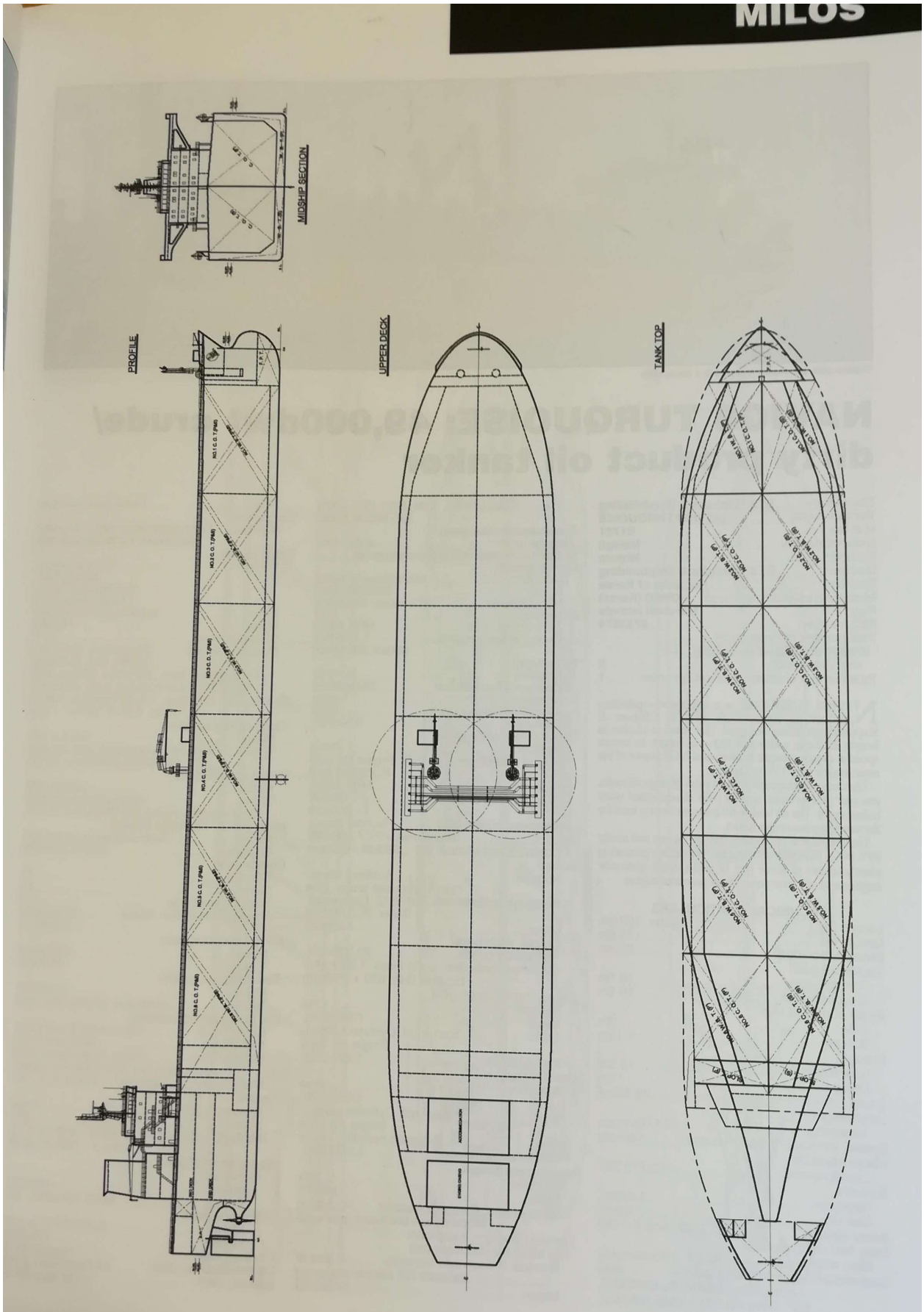
Electric power is generated from three diesel generators driven by an alternator with a 980kW output, and steam is generated by two auxiliary boilers with a capacity of 35,000kg/h and one composite boiler with a capacity of 1,200kg/h (exhaust gas section) and 1,800kg/h (oil fired section).

The vessel has six pairs of cargo oil tanks, two slop tanks, fore and aft peak tanks, segregated water ballast tanks, fuel oil tanks and fresh water tanks. Cargo tanks are divided by plane type transverse and longitudinal bulkheads. Cargo handling is performed by three cargo oil pumps of 4,000m^3/h that are driven by a steam turbine.

Water ballast is handled by two ballast pumps driven by an electric motor. The electrolysis type water ballast treatment system is designed to be environmentally friendly with a capacity of 4,000m^3/h for main and 300m^3/h for APT to service the vessel's ballast tanks. The vessel is fully compliant with the latest environmental guidelines for fuel oil protection, the Inventory of Hazardous Materials for ship's recycling, the Performance Standard for Protective Coatings (PSPC) and IMO Tier II NOx requirements.

TECHNICAL PARTICULARS

Length oa: 277.27m
Length bp: 267m
Breadth moulded: 48m
Depth moulded
To main deck: 23.1m
Draught
Scantling: 17.15m
Design: 16m
Gross: 81,000tonnes
Deadweight
Design: 144,460tonnes
Scantling: 157,460tonnes
Speed, service (-- %MCR output): ..... 14.2knots (71.7% of MCR)
Cargo capacity: ..... 170,000m^3
Bunkers
Heavy oil: ..... 3,700m^3
Diesel oil: ..... 1,000m^3
Water ballast: ..... 53,000m^3
Daily fuel consumption
Main engine only: ..... 40.4 tonnes/day
Classification society and notations: ..... LR /+100A1, Double Hull Oil Tanker, CSR, ESP, ShipRight[ACS(B,C), CM], *IWS, LI, DSPM4, ECO(BWT, IHM, VECS-L, IBTS, BIO, EEDI, SEEMP, P), +LMC, IGS, UMS with descriptive notes ETA, ShipRight[BWMP(S,T), SERS, SCM], COW(LR)
% high-tensile steel used in construction: 52%
Main engine(s)
Design: ..... WinGD
Model: ..... Wärtsilä 6X72
Manufacturer: ..... Hyundai Heavy Industries
Number: 1
Type of fuel: ..... HFO, MGO
Output of each engine: ..... 15,088kW x 71.8rpm
Propeller(s)
Material: ..... Ni. Al. Bronze
Designer/Manufacturer: ..... Sungdong Shipbuilding & Marine Engineering / Hyundai Heavy Industries
Number: 1
Fixed/Controllable pitch: ..... FPP
Diameter: 9m
Speed: 71.8rpm
Diesel-driven alternators
Number: 3
Engine make/type: ..... Yanmar / 6EY22ALW
Type of fuel: ..... HFO, MGO
Output/speed of each set: ..... 1,100kW / 900rpm
Boilers
Number: 2 sets + 1 set
Type: ..... Auxiliary, Composite
Make: ..... Alfa Laval
Output, each boiler: ... Auxiliary - 35,000kg/h x 16/6kg/cm^2.g
Composite (Oil fired/exhaust gas) - 1,800 /1,200kg/h x 6kg/cm^2.g
Cargo cranes/cargo gear
Number: ..... 2 sets
Make: ..... DMC
Type: ..... Electro-hydraulic driven
Performance: ..... SWL 20tonnes
Other cranes
Number: ..... 1 set + 2 sets
Make: ..... DMC
Type: ..... M/E Overhead / Electro-hydraulic driven
Tasks: ..... E/R Crane / Provision handling
Performance: ..... 8tonnes x Span 7.6m / SWL 8tonnes + 2tonnes
Mooring equipment
Number: ..... 9 sets
Make: ..... MacGregor Pusnes
Type (electric/hydraulic/steam): ..... Electro-Hydraulic driven
Special lifesaving equipment
Number of each and capacity: ..... 2 sets x 30 persons
Make: ..... Norsafe
Type: ..... Gravity
Cargo tanks
Number: ..... 6 pairs cargo tanks, 1 pair slop tanks
Cargo pumps
Number: ..... 3 sets
Type: ..... Centrifugal, vertical, single-stage
Make: ..... Shinko
Capacity (each): ..... 4,000m^3/h x 135mTH (based on sea water of 1.025S.G.)
Cargo control system
Make: ..... Shinko
Type: ..... Pump room
Ballast control system
Make: ..... Emerson
Type: ..... Electro-hydraulic
Water Ballast Treatment System
Make: ..... Hyundai Heavy Industries
Capacity: ..... 4,000m^3/h (for Main) + 300m^3/h (for APT)
Complement: ..... 28 persons + 6 Suez crew
Fire detection system
Make: ..... Autronica
Type: ..... Autroprime BS-200M
Fire extinguishing systems
Engine room
Make/Type: ..... Tyco-seaplus, High expansion foam
Radars
Number: ..... S-Band Radar 1ea, X-Band Radar 1ea
Make: ..... JRC
Model(s): ..... JMR-9282-n(S-Band), JMR-9225-6X(X-Band)
Waste disposal plant
Incinerator
Make: ..... Hyundai Marine Machinery
Model: ..... Maxi NG100SL WS
Sewage plant
Make: ..... Ilseung
Model: ISB-03
Contract date: ..... May 2014
Launch/float-out date: ..... August 2016
Delivery date: ..... October 2016


MIDSHIP SECTION
PROFILE
UPPER DECK
TANK TOP

SIFA: First VLCC with BWTS installed

Shipbuilder: **Hyundai Heavy Industries Co., Ltd**
Vessel's name: ***Sifa***
Hull no: **2247**
Owner/operator: **Oman Shipping/NITC**
Country: **Oman**
Designer: **Hyundai Heavy Industries Co., Ltd**
Country: **Korea**
Model test establishment used: **Hyundai Maritime Research Institute**
Flag: **Malta**
IMO number: **9441245**
Total number of sister ships already completed (excluding ship presented): **1**
Total number of sister ships still on order: **1**

The 317,000dwt very large crude carrier (VLCC) *Sifa* was built at Hyundai Heavy Industries Co., Ltd. (HHI) and was delivered to Oman Shipping, on 10 January. *Sifa* is the first of a series of three VLCCs to be constructed for the Oman based ship owner, and is the first VLCC to be fitted with a ballast water treatment system (BWTS).

The Techcross BWTS has been installed to prevent the transfer of harmful aquatic organisms and pathogens in ballast water onboard the vessel and meets with regulatory requirements.

The valve control of the cargo and ballast system is hydraulically operated. Cargo control and monitoring covers ullage measurement, pump operation and inert gas systems. Radar beam type level gauges are fitted to cargo tanks while electro-pneumatic type level gauges are used in the ballast tanks.

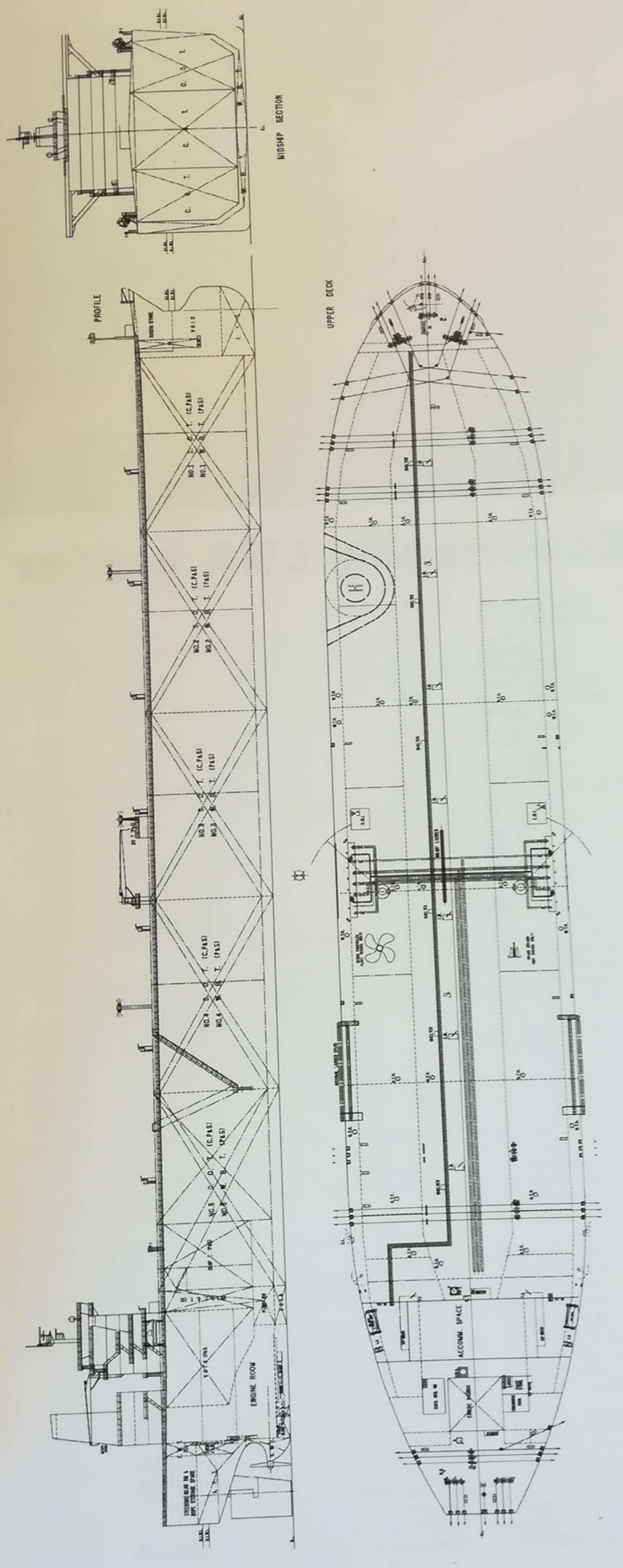
Sifa is designed to carry three grades of cargo simultaneously, handled by three steam turbine cargo pumps, each delivering 5500m³/h and housed in a pump room forward of the engine room. The ship has five centre cargo oil tanks, five pairs of side cargo oil tanks, one pair of slop tanks and water ballast tanks surrounding cargo oil tanks.

The ship has one continuous freeboard deck from stem to stern, transverse bulkheads, four longitudinal bulkheads, and double bottom and double side construction in way of the cargo space.

Sifa is, among others, equipped with a highly advanced navigation system, which supports integrated bridge operations of the ship, such as route planning, manoeuvring for collision and grounding avoidance and navigation monitoring. These green features include a vessel performance system supplied by Kongsberg, designed to reduce fuel consumption and emissions by up to 5%. This system allows continuous online monitoring and control of NOx, SOx and CO_2 emissions from both main and auxiliary engines' exhaust gas. At the same time the information can be transferred to head office by advanced communications systems like VSAT.

TECHNICAL PARTICULARS

Length oa: 333m
Length bp: 319m
Breadth moulded: 60m
Depth moulded
To main deck: 30.4m
To upper deck: 30.4m
Width of double skin
Side: 3.4m
Bottom: 3m
Draught
Scantling: 22.6m
Design: 21m
Gross: 163,000gt
Deadweight
Design: 287,900dwt
Scantling: 316,400dwt
Speed, service: 15.5knots @ 90% MCR with 20% sea margin
Cargo capacity
Liquid volume: 351,200m³
Diesel oil: 1100m³
Water ballast
Tankers – percentage segregated ballast: 98,500m³
Daily fuel consumption
Main engine only: 104.4tonnes/day
Classification society and notations: Lloyd's Register +100A1 Double Hull Oil Tanker ESP, CSR, ShipRight(CM), +LMC, UMS, IGS, COW, LI, SPM, EP, *IWS, NAV1 with descriptive notes of BWMP(S), PCWBT, SCM, SEA(HSS-4, L), Pt,HI
% high-tensile steel used in construction: 35%
Main engine
Design: Hyundai-Wärtsilä
Model: 7RT-Flex 82T
Manufacturer: Hyundai Heavy Industries Co., Ltd
Number: 1
Type of fuel: HFO, MDO
Output of each engine: 31,640kW
Propellers
Material: Ni-Al-Bronze
Designer/manufacturer: Hyundai Heavy Industries Co., Ltd
Number: 1
Fixed/controllable pitch: Fixed
Diameter: 10m
Diesel-driven alternators
Number: 3
Engine make/type: HHI-EMD/ Himsen 8H21/32
Type of fuel: HFO, MDO
Output/speed of each set: 1490kW
Alternator make/type: HHI-EES/ HFJ7/ 634-84E
Output/speed of each set: 1400kW x 900rpm
Boilers
Number: 2
Type: Automatic, Marine boiler (MAC-55B)
Make: Mitsubishi Heavy Industries Co., Ltd
Output, each boiler: 55,000kg/h
Cargo cranes/cargo gear
Number: 2
Make: Oriental Precision & Engineering Co., Ltd
Type: Provisions crane
Performance: 5, 10tonnes
Mooring equipment
Number: 2 x combined winches
8 x windlasses
Make: Rolls-Royce Marine AS
Type: Hydraulic
Special lifesaving equipment
Number of each and capacity: 2 x 50 persons
Make: Hyundai Life Boat Co., Ltd
Type: Freefall launching totally enclosed engine driven
Cargo pumps
Number: 3
Type: Vertical centrifugal signle stage
Make: Shinko
Stainless steel: Bronze
Capacity: 5500m³/h x 150mTH
Cargo control system
Make: Nakakita
Type: Hydraulic/ conventional piano type
Ballast control system
Make: Nakakita
Type: Hydraulic/ conventional piano type
Water ballast treatment system
Make: Techcross
Capacity: 5000m³/h
Complement
Officers: 17
Crew: 10
Bridge control system
Make: Kongsberg
Type: K-chief
One-man operation: Yes
Fire detection system
Make: Consillium
Type: Smoke/thermal/flame detector
Fire extinguishing systems
Pump room: Kashiwa/ Hi-expansion foam
Engine room: Kashiwa/ Hi-expansion foam
Radars
Number: 3
Make: Kongsberg
Model: K-Bridge Radar
Contract date: 11 February 2008
Launch/float-out date: 27 August 2010
Delivery date: 10 January 2011


MIDSHIP SECTION
PROFILE
UPPER DECK
ENGINE ROOM
ACCOMM. SPACE

SPYROS K: Suezmax tanker for Tsakos Energy Navigation Ltd

Shipbuilder: **Sungdong Shipbuilding & Marine Engineering Co., Ltd**
Vessel's name: ***Spyros K***
Hull No: **S2034**
Owner/operator: **Tsakos Energy Navigation Limited**
Country: **Greece**
Designer: **Sungdong Shipbuilding & Marine Engineering Co., Ltd**
Country: **Korea**
Model test establishment used: **MOERI, Korea**
Flag: **Liberia**
IMO number: **9565948**
Total number of sister ships already completed (excluding ship presented): **1**
Total number of sister ships still on order: **nil**

Spyros K is the first in a series of two crude oil tankers for Tsakso Energy Navigation that will both be on an 11 year time charter as part of the company's Suezmax newbuild programme. *Spyros K* was delivered from Sungdong shipyard in May, with its sister ship, *Dimitris P*, delivered later in 2011.

Spyros K has a higher performance efficiency than other vessels in the same class because of the advanced CFD, Shipflow and fluent technology for reduction of resistance and optimisation of the propeller, which has been applied to the design. In this process, particular attention has been paid to the reduction of wave making resistance and optimisation of the pressure distribution, velocity field and streamline pattern over the hull.

The vessel has six pairs of cargo oil tanks, two slop tanks, fore and aft peak tanks, segregated water ballast tanks, fuel oil tanks and fresh water tanks. Cargo tanks are divided by plane type transverse and longitudinal bulkheads. Cargo handling is performed by three cargo oil pumps of 4000m^3/h, driven by stream turbine. The water ballast is handled by two ballast pumps, driven by a steam turbine and electric motor.

The 158,000dwt vessel meets with the Quebec terminal requirement, and is equipped with additional double drum mooring winch/chock/roller at forward of accommodation and silencer provision for engine room ventilation fan and pump room fan. Also the air draft of the vessel is 50.45m from base line to top of radar mast to pass Port Arthur, Martin Luther King Bridge.

Spyros K was constructed under the survey of ABS and designed in accordance with the IACS common structural rules (CSR). The vessel features a double side skin and has a flush deck, bulbous bow, transom stern, open water type stern frame, semi-balanced rudder and single propeller driven by a slow speed diesel engine. The vessel can navigate at a speed of 15.7knots at the design draft with well optimised hull form and propeller design.

Spyros K meets with the latest environmental guidelines such as fuel oil protection, green passport for ship's recycling, performance standard for protective coatings (PSPC), IMO Tier II NOx requirement, M.G.O. tank for European Ports and the ABS ES notation.

TECHNICAL PARTICULARS

Length oa: 274.2m
Length bp: 264m
Breadth moulded: 48m
Depth moulded
- To main deck: 23.1m
- To upper deck: 23.1m

Width of double skin
- Side: 2.5m
- Bottom: 2.8m

Draught
- Scantling: 17.15m
- Design: 16m

Gross: 81,000tonnes
Deadweight
- Design: 145,000dwt
- Scantling: 158,000dwt

Speed, service: 15.7knots @ 90% mCR with 15% sea margin

Cargo capacity
- Liquid volume: 170,000m^3

Bunkers
- Heavy oil: 4500m^3
- Diesel oil: 200m^3

Water ballast: 54,000m^3
Daily fuel consumption
- Main engine only: 69.3tonnes/day

Classification society and notations: ABS A1(E), Oil Carrier, ESP, CRS, AB-CM, CPS, UWILD, +AMS, +ACCU, TCM, COW, VEC-L, BWE, ENVIRO, HM2+R, CRC, RW, PMA, GP
% high tensile steel used in construction: abt. 40%
Main engine
- Design: 2-stroke, direct revidible, crosshead
- Model: 6S70MC-C7 Tier II
- Manufacturer: Hyundai-MAN B&W
- Number: 1
- Type of fuel: HFO, MDO or MGO
- Output of each engine: 18,660kW x 91rpm

Propeller
- Material: Ni-Al-Bronze
- Designer/manufacturer: HHI
- Number: 1
- Fixed/controllable pitch: Fixed
- Diameter: 8.2m
- Speed: 91rpm

Diesel-driven alternators
- Number: 3
- Engine make/type: HHI/ Himsen 6H21/32
- Type of fuel: HFO, MDO or MGO
- Output/speed of each set: 1050kW/ 720rpm
- Alternator make/type: HHI-EES/ HFC7-564-14E
- Output/speed of each set: 987kW/ 720rpm

Boilers
- Number: 2 x Aux. boilers 1 x comp. boiler
- Type: oil fired, vertical, water tube & forced draft
- Make: Aalborg
- Output, each boiler:
- Aux boiler: 37,200kg/h
- Comp. boiler: 1500kg/h oil fired 1200kg/h exh. Gas

Cargo cranes/ cargo gear
- Number: 2
- Make: Oriental
- Type: Electro hydraulic, cylinder luffing jib rest
- Performance: 15tonnes/ 17.4m outreach

Other cranes
- Number: 2
- Make: Oriental
- Type: Electro hydraulic, cylinder luffing jib rest
- Tasks: Provisions
- Performance: 6.3tonnes/ 4m outreach, 2tonnes/ 4m outreach

Mooring equipment
- Number: 9
- Make: Rolls-Royce
- Type: Hydraulic/ high pressure

Special lifesaving equipment
- Number of each and capacity: 2 x 29 persons
- Make: Hyundai lifeboats Co., Ltd
- Type: Totally enclosed lifeboat

Cargo tanks
- Number: 6
- Grades of cargo carried: Crude oil
- Coated tanks, make and type: Nippon/Epoxy

Cargo pumps
- Number: 3
- Type: Centrifugal steam turbine
- Make: Shinko pump Japan
- Stainless steel: Impeller shaft
- Capacity: 4000m^3/h x 135mTH

Cargo control system
- Make: ACE valve Korea
- Type: Console & VDU

Ballast control system
- Make: ACE valve Korea
- Type: Console & VDU

Complement
- Officers: 11
- Crew: 18

Bridge control system
- Make: Nabtesco
- Type: M-80000III

Fire detection system
- Make: Autronica Dire and Secrueity
- Type: Autoprime

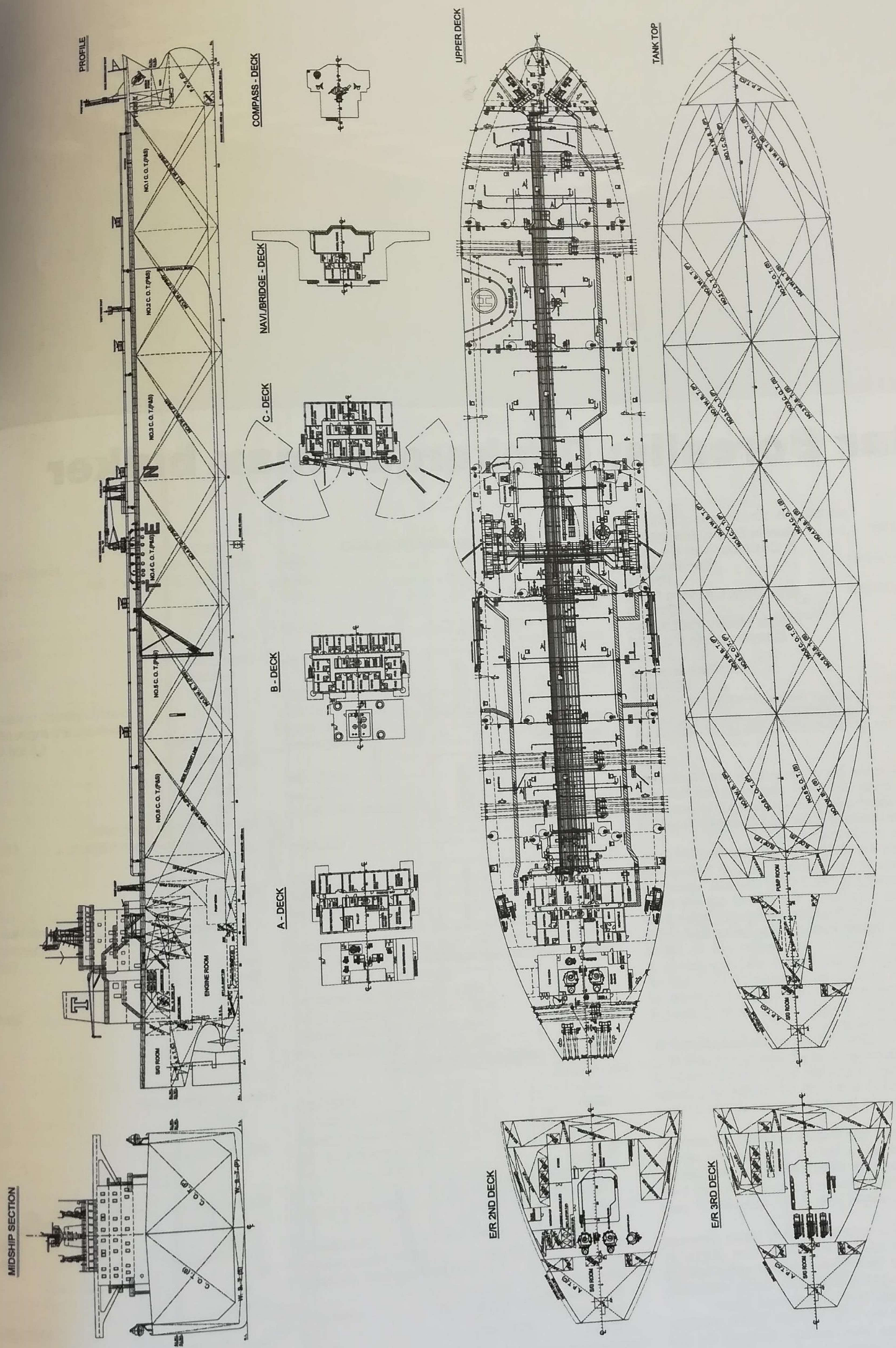
Fire extinguishing systems
- Cargo holds: NK/ Deck foam
- Engine room: NK/ CO_2
- Public spaces: Seaplus/ Low pressure system

Radars
- Number: 2
- Make: JRC
- Models: JMA-9132-SA/ 9122-9XA

Waste disposal plant
- Incinerator: Teamtec GS500CS
- Waste compactor: Samjoo/ TT 160
- Sewage plant: Jonghap/ JMC-18N073

Contract date: 14 July 2009
Launch/float-out date: 1 February 2011/ 11 Februaury 2011
Delivery date: 12 May 2011

SPYROS K


PROFILE
COMPASS - DECK
NAVI./BRIDGE - DECK
C - DECK
B - DECK
A - DECK
UPPER DECK
TANK TOP
MIDSHIP SECTION
E/R 2ND DECK
E/R 3RD DECK
ENGINE ROOM

Pictured Samco Redwood sister ship of Samco Amazon

SAMCO AMAZON: Energy saving VLCC

Shipbuilder:	**Hyundai Samho Heavy Industries Co.Ltd**
Vessels name:	***Samco Amazon***
Hull No:	**S501**
Owner/operator:	**Samco Eta Ltd/ Samco Shipholding Pte Ltd**
Country:	**Singapore**
Designer:	**Hyundai Samho Heavy Industries Co., Ltd**
Country:	**Korea**
Model test establishment used:	**Hyundai Maritime Research Institute**
Flag:	**Marshall Islands**
IMO number:	**9528794**
Total number of sister ships already completed (excluding ship presented):	**nil**
Total number of sister ships still on order:	**3**

Samco Amazon is the first in a series of four very large crude carriers (VLCCs) that are to be constructed at Korean shipyard Hyundai Samho Heavy Industries for the Singapore based shipping company, Samco Shipholding Pte Ltd., and was delivered on 25 August.

A hull stress monitoring system, which enables real-time monitoring, is fitted in the vessel that gives it a high degree of operational flexibility by minimising damage due to hull fatigue stress and also optimises a voyage, through the ship management. A Mewis Duct has also been fitted to the vessel, which consists of a duct and a propeller with an integrated fin system, which contributes largely to the fuel saving potential of 5~7% and the reduction of polluting emissions as well as the improvement in speed of the vessel.

Samco Amazon has been fitted with the latest in energy saving devices such as a Waste Heat Recovery System(WHRS) and a Hyundai-Wärtsilä 7RT-Flex82T main engine and Delta Tuning. The environmentally-friendly technology encapsulated in the WHRS allows the vessel to increase the fuel efficiency through the reuse of high temperature exhaust gas generated from a variety of equipment during the vessels operation.

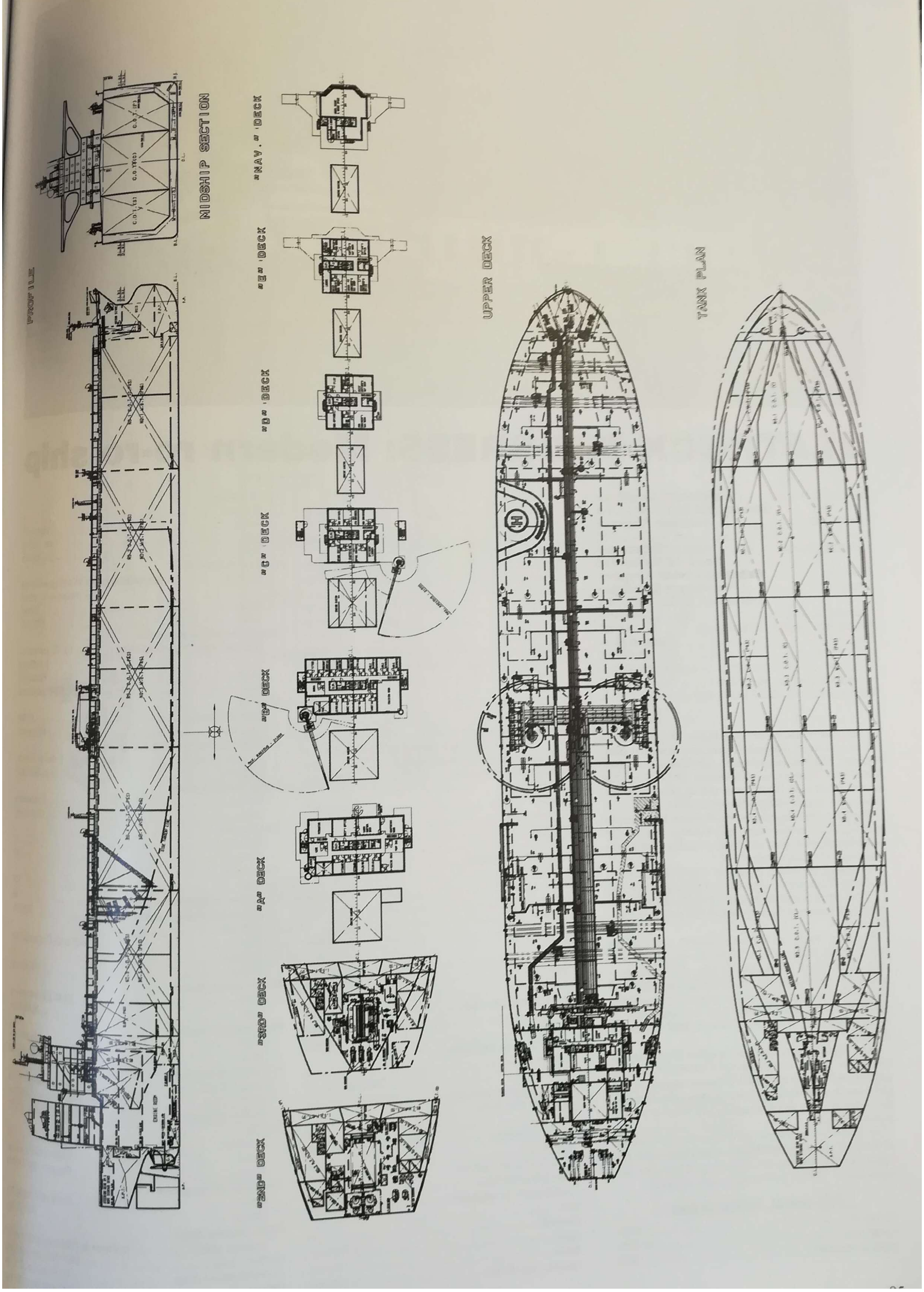
The Delta Tuning is an option of the RT-flex engine supplied by Wärtsilä, which enables a main engine to reduce SFOC (Specific Fuel Oil Consumption) through variations of fuel injection timing and exhaust valve timing under the condition of NCR load and thus provides significant fuel savings as compared to a conventional engine.

The vessel has, amongst its many green credentials, a ballast water treatment system installed onboard by Samgong Co. Ltd that has a capacity of 6350m^3. The vessel is also compliant with the Performance Standard for Protective Coatings (PSPC) and the IACS common structural rules (CSR), enhancing the structural integrity of the vessel as a whole.

TECHNICAL PARTICULARS

Length oa	333.08m
Length bp	319.00m
Breadth moulded	60.00m
Depth moulded	
To main deck	30.40m
To upper deck	30.40m
To other decks	28.60m (mooring deck)
Width of double skin	3.4m
Side:	3.0m
Bottom:	
Draught	22.60m
Scantling:	21.00m
Design:	160,928gt
Gross:	abt 364,000tonnes
Displacement:	
Deadweight	abt. 289,000dwt
Design:	abt. 314,250dwt
Assigned:	0.8201
Block co-efficient:	16.6knots @90% MCR
Speed, service:	352,500m^3
Cargo capacity:	
Bunkers	7300m^3
Heavy oil:	1500m^3
Diesel oil:	98,300m^3
Water ballast:	96.11%
Tankers- percentage segregated ballast:	
Daily fuel consumption at assigned dwt	
Main engines only:	107.0tonnes/day
Classification society and notations:	ABS, +A1, Oil Carrier, (E), (+)AMS, (+)ACCU, NIBS, VEC-L, TCM, AB-CM, BWE, CSR, ENVIRO, GP, POT, PMA, RRDA,ESP, UWILD, CPS, CRC, HM2+R Hull Girder Stress, RW, SPMA
Main engines	
Design:	Wärtsilä
Model:	7RT Flex82t R1+
Manufacturer:	Hyundai
Number:	1
Type of fuel:	HFO, MDO or MGO
Output of each engine:	31,640kW x 80.0rpm
Propellers	
Material:	Ni-Al-Bronze
Design/manufacturer:	Hyundai
Number:	4
Fixed/controllable pitch:	Fixed
Diameter:	10.1m
Speed:	80rpm
Diesel-driven alternators	
Number:	2 +1
Engine make/type:	Hyundai-Himsen (6H21/32) (5H17/28)
Type of fuel:	HFO, MDO or MGO
Output/speed of each set:	1200kW/900rpm 575kW/900rpm
Alternator make/type:	Hyundai/HFC7-566-84K Hyundai/HFC7-456-84K
Output/speed of each set:	1130kW/900rpm 530kW/900rpm
Turbo-generator (for WHRS)	
Number:	1
Design/manufacturer:	Shinko
Alternator make/type:	Hyundai/ HFJ7-566-44E
Output/speed:	1500/180rpm
Boilers	
Number:	2
Type:	Automatic, forced draft, HFO burning
Make:	Aalborg
Output, each boiler:	45,000kg/h
Cargo cranes/cargo gear	
Number:	2
Make:	Oriental Precision & Engineering Co., Ltd
Type:	Electro hydro driven
Performance:	20tonnes
Other cranes	2
Number:	Oriental Precision & Engineering Co., Ltd
Make:	Electro Hydro driven
Type:	Provisions
Tasks:	10tonnes, 3tonnes
Performance:	
Mooring equipment	10
Number:	Aker Pusnes
Make:	Electro-Hydraulic
Type:	
Special lifesaving equipment	2 sets x 40 persons
Number of each and capacity:	Hyundai lifeboats
Make:	Hinged gravity type
Type:	
Cargo tanks	17
Number:	crude oil
Grades of cargo carried:	Modified epoxy on ceiling, T/Top
Coated tanks – make and type of coating:	
Cargo pumps	3
Number:	Vertical, centrifugal single stage
Type:	Shinko Ind., Ltd
Make:	5000m^3/hr x 150tonnes/h
Capacity:	
Cargo control system	Nakakita
Make:	Cargo control console of piano type
Type:	
Ballast control	Nakakita
Make:	Cargo control console of piano type
Type:	
Water ballast treatment system	Samgong Co.Ltd
Make:	6350m^3/h
Capacity:	
Complement	10
Officers:	19
Crew:	6
Suez/repair crew:	
Stern appendages/special rudders:	Mewis Duct
Bridge control system	Hyundai-EES
Make:	Self standing
Type:	Yes
One-man operation:	
Fire detection system	Consilium
Make:	Salwico Cargo
Type:	
Fire extinguishing systems	CO_2 NK/High pressure CO_2
Engine room:	Dry powder NK/ portable extinguisher
Public spaces:	
Radars	Two
Number:	JRC
Make:	S-Band: JMA-9132-SA X-Band: JMA-9122-6XA
Model:	
Waste disposal plant	Kangrim KFB-110S
Incinerator:	Hamworthy ST3A-C
Sewage plant:	14 July 2008
Contract date:	23 April 2011
Launch/float-out date:	25 August 2011
Delivery date:	

SAMCO AMAZON



AMJAD: Very large crude carrier

Shipbuilder: .....**Hyundai Samho Heavy Industries Co. Ltd**
Vessel's name: ..... ***Amjad***
Hull No: **S842**
Owner/Operator: .....**The National Shipping Company of Saudi Arabia**
Country: ..... **Kingdom of Saudi Arabia**
Designer: ...**Hyundai Samho Heavy Industries Co. Ltd**
Country: .....**Republic of Korea**
Model test establishment used: .....**SSPA**
Flag: ..... **Saudi Arabia**
IMO number: **9779800**
Total number of sister ships already completed (excluding ship presented): **4**

AMJAD is the first in class of a total of 10 Very Large Crude Carriers (VLCCs) which are being built by Hyundai Samho Heavy Industries (HHI) and are to be owned by Saudi Arabia's state-run shipping company, Bahri Ship Management. *Amjad* – which means 'Glory' in Arabic – is 333 metres long and 60 metres wide. It is capable of carrying 300,000 tons of oil. Each of the vessels in the class is worth an estimated US$85-95 million and they are being delivered to the Saudi company under a contract signed in 2015. Delivery of all vessels is due by the end of 2018.

These VLCCs will boast a number of devices designed to save energy and improve performance. These include a HHI pre-swirl duct and a Hyundai end-plated cap fin (Hi-Fin), which saves fuel by breaking up the hub vortex generated behind the rotating propeller, resulting in improved hydrodynamic performance. A full-spade rudder with Hyundai X-twisted leading edge also features, and all will be fitted with a Hyundai Ballast Water Treatment System which is stated to offer economy of operation.

TECHNICAL PARTICULARS

Length oa: 332.97m
Length bp: 322m
Breadth moulded: 60.00m
Depth moulded
To upper deck: 29.4m
Width of double skin
Side: 3.0m
Bottom: 2.9m
Draught
Scantling: 21.6m
Design: 20.5m
Gross: 154,252t
Displacement: 132,524t
Lightweight: 43,756t

Deadweight
Design: 279,405dwt
Scantling: 298,886dwt
Block co-efficient (please state relevant draught): 0.7208
Speed, service: .. 14.72knots at design draught
Liquid volume: 342,059.6
Bunkers (m^3)
Heavy oil: 7401.8
Diesel oil: 1,033.9
Water ballast (m^3): 91,421.7
Daily fuel consumption (tonnes/day)
Main engine only: .....169.17 g/kW·hr (MCR)

Classification society and notations: .....LR +100A1 Double Hull Oil Tanker, CSR, ESP, ShipRight (CM, FDA plus (40, WW), ACS (B,C)), *IWS, LI, DSPM4, ECO (BWT, IHM, P, SEEMP) +LMC, IGS, UMS, NAV1, Descriptive Note: ShipRight (BWMP (S, T), SCM, SERS, VECS)

% high-tensile steel used in construction: .. 49.7

Main engine
Design: .....Hyundai-Wärtsilä
Model: W7X82
Manufacturer: .....Hyundai Heavy Industries Co., Ltd, Engine & Machinery Division
Number: 1
Type of fuel: .....HFO
Output: 24,000kW
Propeller
Material: .....Ni-Al-Bronze
Designer/Manufacturer: .....Hyundai Heavy Industries Co., Ltd, Engine & Machinery Division
Number: 1
Fixed/Controllable pitch: ..... Fixed
Diameter: 10,300mm
Diesel-driven alternators
Number: 3
Engine make/type: .....Hyundai Heavy Industries Co., Ltd, Engine & Machinery Division/Himsen 7H21/32
Type of fuel: .....HFO
Output/speed of each set: 1,490kW / 900rpm
Alternator make/type: .....Hyundai Electric & Energy Systems Co., Ltd / HFC7 632-08P
Output/speed of each set: 1,400kW / 900rpm
Boilers
Number: 3
Type: .....MAC-50B x 2 / Aalborg OS-TCi x 1
Make: ..... Mitsubishi Heavy Industries Co., Ltd / Alfa Laval
Output, each boiler: .....50,000kg/h x 2 / 2,400kg/h x 1
Cargo cranes/cargo gear
Number: 2
Make: ..... Oriental Precision & Engineering Co., Ltd.
Type: .....Electro-Hydraulic type
Performance: .....SWL 20t
Other cranes
Number: 2
Make: ..... Oriental Precision & Engineering Co., Ltd.
Type: ..... Electro-hydraulic type
Tasks: .....Provisions crane
Performance: .....SWL 9.5t, 3t

Other cranes
Number: 1
Make: .....Dongnam Marine Crane Co., Ltd.
Type: ..... Magnetic disc brake
Tasks: .....Engine room crane
Performance: .....SWL 9.5t

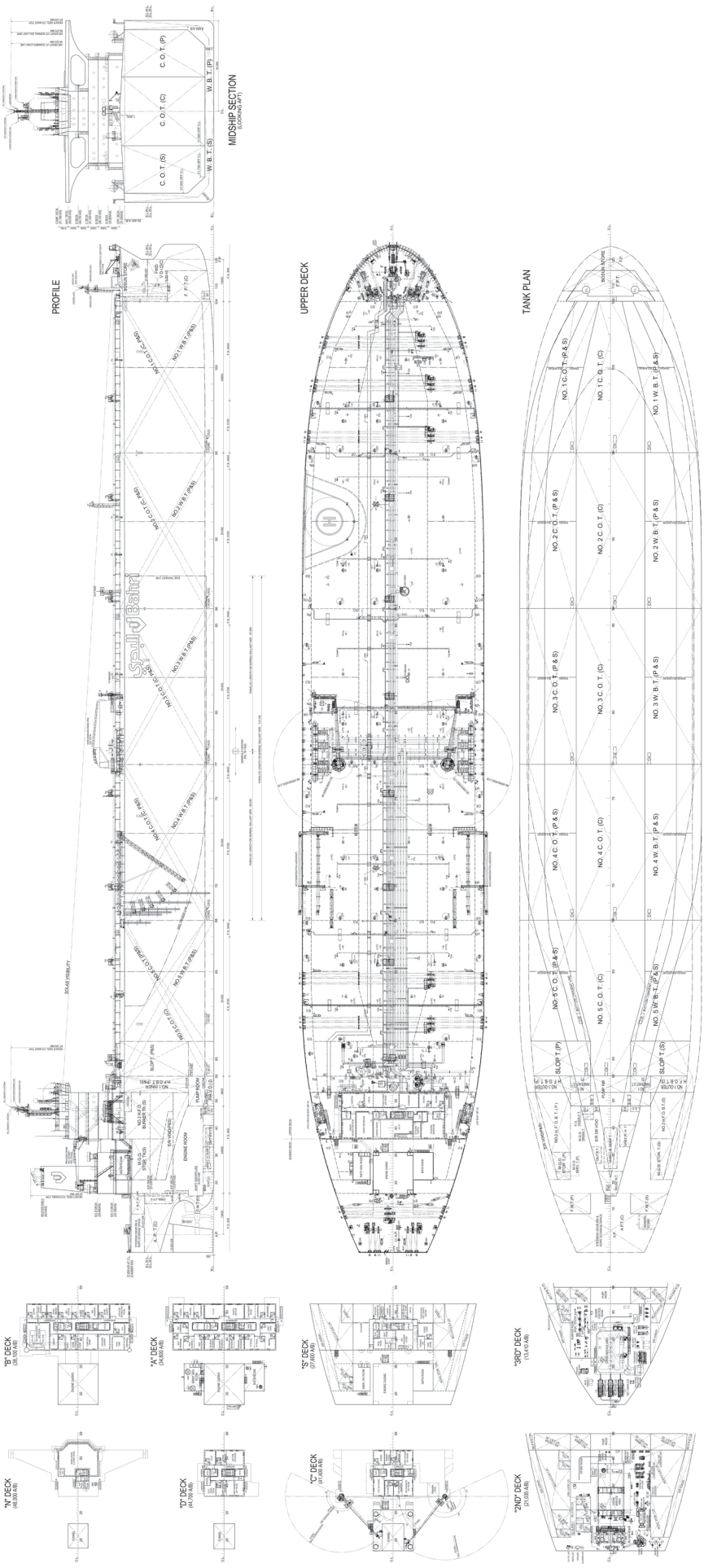
Mooring equipment
Number: 9
Make: .....Macgregor
Type (electric/hydraulic/steam): .....Hydraulic

Special lifesaving equipment
Number of each and capacity: ..... 2 / 36 persons
Make: ..... Hyundai Lifeboats Co., Ltd
Type: .....Totally enclosed lifeboat

Cargo tanks
Number: 17
Grades of cargo carried: .....Crude oil
Coated tanks – make and type of coating: .... Jotun / Jotacote Universal N10
Cargo pumps
Number: 3
Type: KV450-4
Make: .....Shinko Industries Ltd.
Capacity (each): ..... 5,000m^3/h
Cargo control system
Make: ..... VAF Instruments
Type: ..... OILCON MARK 6M
Ballast control system
Make: ..... Nakakita Seisakusho Co., Ltd
Type: .....Hydraulic and remote control
Water ballast treatment system
Make: .... Hyundai Heavy Industries Co., Ltd, Engine & Machinery Division
Capacity: ..... 6,000m^3/h
Complement
Officers: 17
Crew: 19
Bridge control system
Make: ....Hyundai Electric & Energy Systems Co., Ltd.
Type: ..... Console
Is bridge fitted for one-man operation? ...Yes
Fire detection system
Make: .....Consilium Marine AB
Type: .....Unit of control panel
Fire extinguishing systems
Cargo holds: ..... Fixed Foam
Make/Type: ..... NK Co., Ltd. / foam
Engine room: .....CO_2
Make/Type: .. NK Co., Ltd. / high-pressure
Cabins: .....Water spray system
Radars
Number: 2
Make: ..... JRC
Model: JMR-9225-6X/S
Waste disposal plant
Incinerator
Make: Hyundai Marine Machinery Co., Ltd
Model: MAXI 1500SL WS
Sewage plant
Make: ..... Il Seung Co., Ltd.
Model: ISB-06

Contract date: ..... 21 May 2015
Launch/float-out date: ..... 16 December 2016
Delivery date: .....7 February 2017

AMJAD


MIDSHIP SECTION
PROFILE
UPPER DECK
TANK PLAN
"B" DECK
"A" DECK
"S" DECK
"3RD" DECK
"N" DECK
"D" DECK
"C" DECK
"2ND" DECK

AQUAPAMPERO: Ecuador-max cargo oil tanker

Shipbuilder: .....**Samsung Heavy Industries Co., Ltd**
Vessel's name: ..... ***Aquapampero***
Hull No: **SN2178**
Owner/Operator: .....**Unisea Shipping Ltd**
Country: ..... **Greece**
Designer: **Samsung Heavy Industries Co., Ltd**
Country: .....**Republic of Korea**
Model test establishment used: ..... **SSMB (Samsung Ship Model Basin)**
Flag: ..... **Liberia**
IMO number: **9778674**
Total number of sister ships already completed (excluding ship presented): **4**

AQUAPAMPERO is a 113,000dwt Ecuador-max cargo oil tanker. The first of a series of four, it was built for UNISEA Shipping Ltd by Samsung Heavy Industries Co., Ltd and is suitable for worldwide operation.

A series of targets were set for effective, efficient and environmentally sustainable vessel operation. Fuel consumption will be drastically improved by comparison with previous Ecuador-max tankers. The vessel therefore uses a MAN D&T G-type engine and its EEDI index distinguishes it from other tanker designs. Environmental features include the use of low-sulphur fuel oil (MDO DMA), a ballast water treatment system, and EPA (Environmental Protection Agency), VGP (Vessel General Permit) and EAL (Environmentally Acceptable Lubricants) stern-tube compliance.

In operation, Panama Canal requirements will be fulfilled without restrictions and cargo-loading capacity will be greater than previous generations of Aframax tankers.

Robustness and reliability were further aims. The hull structural design has a 30-year fatigue life and there are PSPC coatings for the cargo and ballast tanks.

TECHNICAL PARTICULARS

Length oa: 244m
Length bp: 234.0m
Breadth moulded: 43.0m
Depth moulded
  To main deck: 21.8m
  To upper deck: 21.8m
Width of double skin
  Side: 2.35m
  Bottom: 2.4m

Draught
  Scantling: 15.2m
  Design: 15.2m

Gross: 61,888gt
Deadweight
  Design: 113,000dwt
  Scantling: 113,000dwt

Speed, service (85 %MCR output): 14.5knots
Cargo capacity (m^3)
  Liquid volume: 126,000
Bunkers (m^3)
  Heavy oil: 2,700
  Diesel oil: 500
Water ballast (m^3): 38,000

Daily fuel consumption (tonnes/day)
  Main engine only: 41.1

Classification society and notations: ..... ABS ✠A1(E), "Oil Tanker", CSR, AB-CM, ✠AMS, ✠ACCU, ESP, VEC, TCM, SPMA, POT, PMA, CPS, ENVIRO, UWILD (no sea chest blanking device), BWT, BWE, GP, RRDA, CRC, RW, SEC*, CPP
Main engine
  Design: ..... MAN B&W
  Model: 6G60ME-C9.5
  Manufacturer: .....Doosan Engine
  Number: 1
  Type of fuel: ..... HFO and MGO
  Output of each engine: 12,420kW
Propeller
  Material: .....Ni-Al-Bronze
  Designer/Manufacturer: .....Silla Metal
  Number: 1
  Fixed/Controllable pitch: ..... Fixed
  Diameter: 8,000mm
  Speed: 79.9rpm
Diesel-driven alternators
  Number: 3
  Engine make/type: ..... Yanmar
  Type of fuel: ..... HFO and MGO
  Output/speed of each set: ..... 1,020kW at 900rpm
Boilers
  Number: 3
  Type: .....Oil-fired
  Make: .....Kangrim Heavy Industries
  Output, each boiler: .....25,000kg/h x 2sets + 1,000/700kg/h x 1set
Cargo cranes/cargo gear
  Number: 2
  Make: ..... DMC
  Type: ..... Jib-type, electro-hydraulic driven
  Performance: .....SWL 15t
Other cranes
  Number: 2
  Make: ..... DMC
  Type: ..... Jib-type, electro-hydraulic driven
  Tasks: .....Provision-handling cranes
  Performance: .....SWL 4t
Mooring equipment
  Number: .....8 sets
  Make: .....Flutek
  Type: ..... Electro-hydraulic driven (high-pressure)
Special lifesaving equipment
  Number of each and capacity: . 2, 30 people
  Make: ..... HLB
  Type: .....Gravity-type

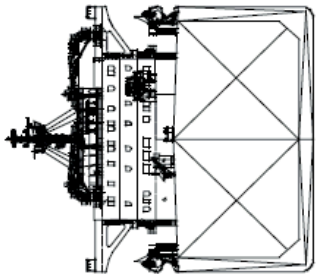
Cargo tanks
  Number: .....12 cargo tanks and two 2 slop tanks
  Product range: .....Crude oil
Cargo pumps
  Number: 3
  Type: .....Vertical, single-stage, centrifugal, steam turbine-driven
  Make: ..... Shinko
  Stainless steel: ..... Impeller shaft, etc.
  Capacity (each): .....3,200 m^3/h x 130 mlc
Cargo control system
  Make: ..... SCANA
  Type: .....Electro-hydraulic system
Ballast control system
  Make: ..... SCANA
  Type: .....Electro-hydraulic system
Water ballast Treatment System
  Make: ..... Samsung Heavy Industries
  Capacity: ..... 4,000m^3/h

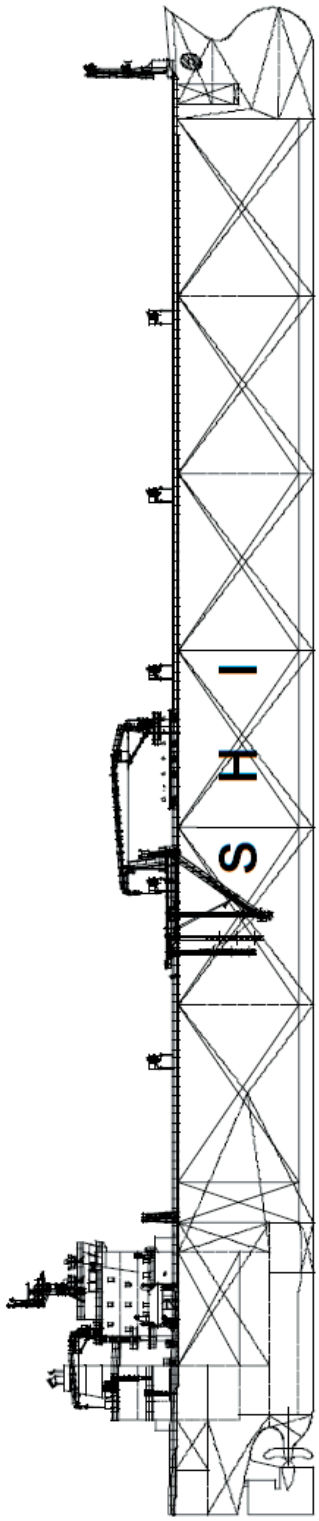
Complement
  Officers: 15
  Crew: 13
  Suez/Repair Crew: 6
  Single/double/other rooms: 4 day/bedrooms, 24 single rooms, 1 Suez crew room
Bridge control system
  Make: ..... NABTESCO
  Type: .....M-800 V
  Is bridge fitted for one-man operation? ....No

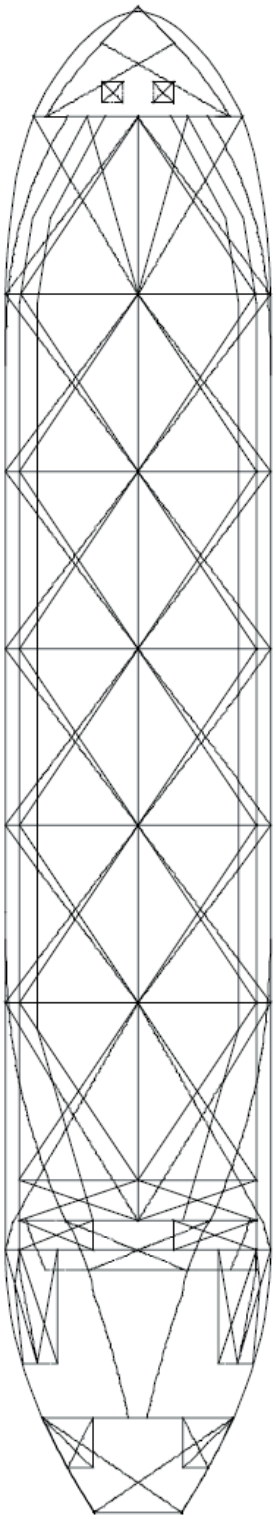
Fire detection system
  Make: .....TYCO SEAPLUS
  Type: .....Addressable type
Fire extinguishing systems
  Engine room:
    Make/Type: ..... KASHIWA/High expansion foam system
  Cabins:
    Make/Type: ... Sea water fire extinguishing system
  Public spaces:
    Make/Type: ... Sea water fire extinguishing system
Radars
  Number: 2
  Make: ..... JRC
  Model(s): .....S-Band: JMR-9282-S / X-Band: JMR-9225-6X
Waste disposal plant
  Incinerator
    Make: ..... Hyundai Marine Machinery
    Model: .....MAXI NG 150SL WS
  Waste shredder/crusher
    Make: ..... Samjoo Engineering
    Model: BS510
  Sewage plant
    Make: ..... Il Seung
    Model: ISB-03

Contract date: ..... 26 March 2015
Launch/float-out date: ..... 17 December 2016
Delivery date: ..... 22 March 2017

AQUAPAMPERO







BLACK DUCK: Small asphalt tanker

Shipbuilder: ..... **Chengxi Shipyard Co., Ltd CSSC**
Vessel's name: ..... ***Black Duck***
Hull No: **CX5401**
Owner/Operator: ..... **Southern Pacific Holding Corporation, Kumiai Senpaku, Co. Ltd**
Country: ..... **Japan**
Designer: ..... **Shanghai Merchant Ship Design & Research Institute, CSSC (SDARI)**
Country: ..... **China**
Model test establishment used: **CSSRC, SSSRI**
Flag: ..... **Marshall Islands**
IMO number: **9799109**
Total number of sister ships already completed (excluding ship presented): **0**

The 7,800dwt *Black Duck* is the first of a new generation of small asphalt tankers designed for worldwide operations. Designed and developed by SDARI for Kumiai Senpaku Co., it is also the first asphalt tanker to be delivered by the Chengxi Shipyard.

The vessel complies with OCIMF, MESQAC, Panama Canal and Suez Canal navigation rules, St. Lawrence Seaway regulations, and is also suitable for navigating in restricted waters with low air draught.

Black Duck is designed to carry bitumen and oil products with flash points greater than 60°C and cargoes with temperatures of up to 200°C. The cargo tanks are of independent type and well insulated. They are divided into two blocks with each block subdivided into four watertight compartments. Efficient cargo handling is achieved with two frequency-controlled cargo pumps, which are also used as stripping pumps. Up to three different kinds of liquid cargo can be carried simultaneously.

This vessel has been designed with energy savings, environmental awareness and safe, economic operation in mind. The hull lines have been optimised using CFD calculation to obtain better power performance in operational profile condition, while rudder lines and aft appendages have been optimised to achieve a short vessel with a good balance of power and manoeuvring performance. The results have been verified by model testing by both the Chinese Ship Scientific Research Center and the Shanghai Ship and Shipping Research Institute. The daily fuel oil consumption of the main engine is 10.4 tonnes/day at a service speed of 13.24knots and a 6.7m draft and the EEDI Index figure achieved is below that required by EEDI Phase 2. *Black Duck* features vibration characteristics far below the ISO standard value for Slight. The vessel's noise levels meet Resolution MSC.337(91), which provides a new code for noise levels onboard ships.

TECHNICAL PARTICULARS

Length oa: 119m
Length bp: 112m
Breadth moulded: 20.4m
Depth moulded
To upper deck: 10.65m
Width of double skin: 1.5m
Draught
Scantling: 6.7m
Design: 6.7m

Gross: 7,538gt
Deadweight:
Design: 7,894.8dwt
Speed, service (75% MCR output): ..13.24knots

Cargo capacity (m^3)
Liquid volume: ..... 8,072.8m^3
Bunkers (m^3)
Heavy oil: 521
Diesel oil: 248
Water ballast (m^3): 3,057
Percentage segregated ballast: 100%

Daily fuel consumption (tonnes/day)
Main engine only: 10.5
Auxiliaries: 2.45

Classification society and notations:
ABS + A1, (E), Fuel Oil Carrier (Asphalt Carrier with Independent Tanks), BWT, UWILD+AMS, +ACCU, VEC, CPS, TCM, GP, RRDA, CRC 2

% high-tensile steel used in construction: ~70%

Main engines
Design: ..... MAN B&W
Model: ..... 6S35ME-B9.5 -TII
Manufacturer: ..... Hudong Heavy Machinery Co. Ltd
Number: 1
Type of fuel: ..... HFO/LSMGO
Output: ..... 3,400kW x 127rpm

Propeller
Material: ..... Ni-Al-Bronze
Designer/manufacturer: SDARI / Changzhou Zhonghai Marine Propeller Co., Ltd
Fixed/controllable pitch: ..... Fixed
Diameter: 4.5m
Speed: 127rpm
Diesel-driven alternators
Number: 3
Engine make/type: ..... Yanmar Co., Ltd / 6EY18LW
Type of fuel: ..... HFO / LSMGO
Output/speed of each set: . 560kW x 720rpm
Alternator make / type: ... Hansin Electric Mfg *FE 5478-10
Boilers
Number: 2
Type: Vertical, cylindrical, shell-and-tube type with full automation and pressure atomising burner
Make: ..... C&S GESAB (Shanghai) Boiler Co., Ltd
Output: ..... 1,800kW each
Other cranes
Number: 1
Make: ..... South China Marine Machinery Co., Ltd
Type: ..... Electro-hydraulic
Tasks: ..... Cargo hose crane
Performance: ..... 5t - 15m
Mooring equipment
Number: 4
Make: ..... Jiang su Masada Heavy Industries Co, Ltd
Type: ..... Hydraulic

Special lifesaving equipment
Number of each and capacity: ... 20 persons
Make: .. CSSC Nanjing Luzhou Machine Co., Ltd
Type: ..... free-fall lifeboat

Cargo tanks
Number: 8
Grades of cargo carried: ..... Asphalt and product oil (flash point >60°C)
Cargo pumps
Number: 2
Type: ..... Screw pump
Make: ..... Bornemann
Capacity (each): ..... 500m^3/h
Cargo control system
Make: ..... Danfoss
Water ballast treatment system
Make: .... Sunrui Marine Engineering Co., Ltd
Capacity: ..... 500m^3/h

Complement
Officers: 11
Crew: 9
Suez repair crew: 6
Single/double/other rooms: ... All single-room

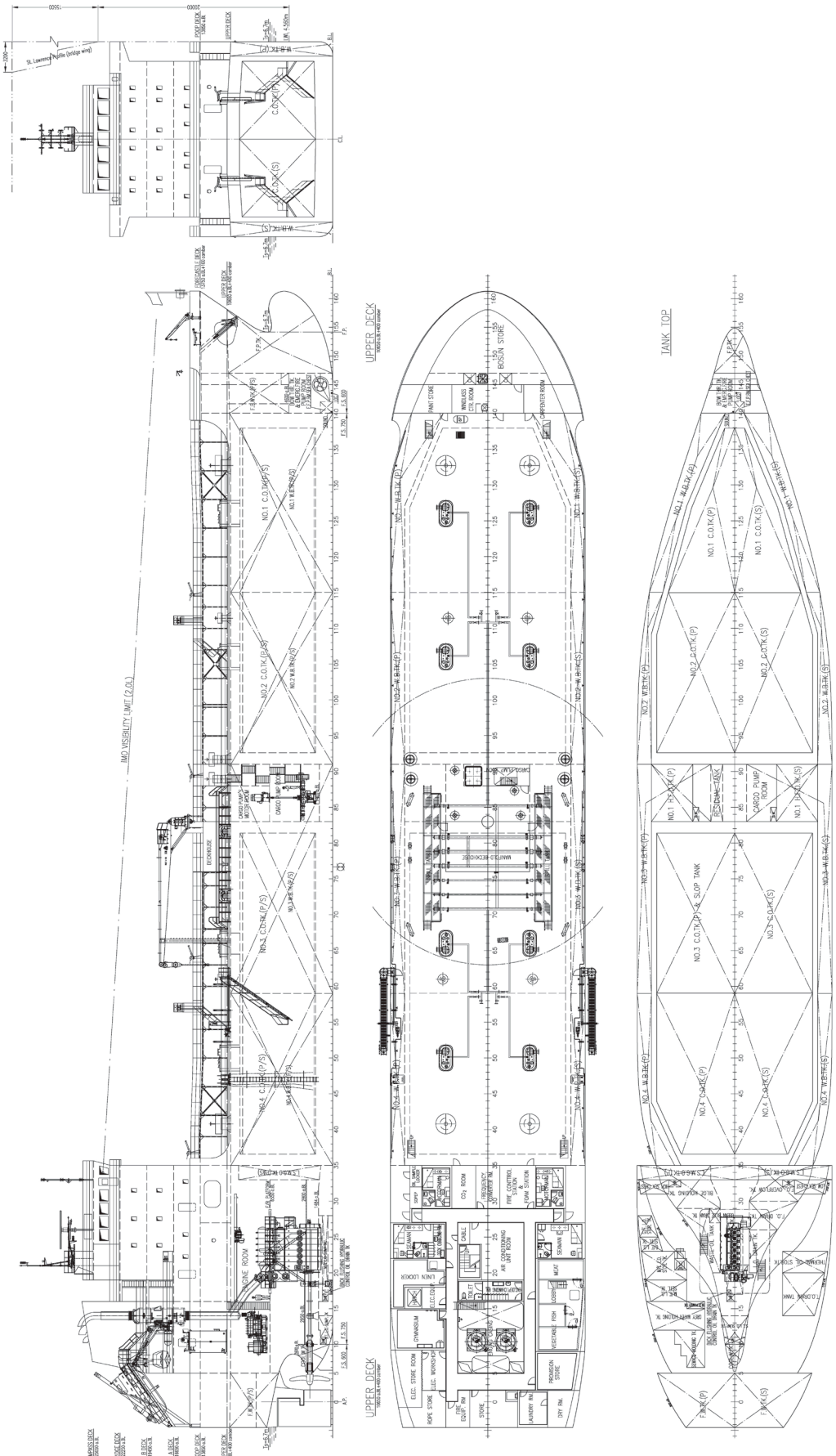
Stern appendages / special rudders: ... Skeg, 1 semi-spade rudder
Bow thrusters
Make: ... Wuhan Kawasaki Marine Machinery Co., Ltd
Number: 1
Output: 400kW

Bridge control system
Make: ..... Eletek

Fire detection system
Make: ..... Consilium
Type: ..... Salwico CCP
Fire extinguishing systems
Deck area make / type: ..... Tyco / fixed deck foam fire-extinguishing system, and sea water
Engine room make / type: Tyco fixed high-pressure CO_2, Tyco fixed water mist fire-fighting system and sea water
Cabins: ..... Sea water and portable fire extinguisher
Public spaces: ... Sea water and portable fire extinguisher
Radars
Number: 2
Make: ..... Furuno
Models: FAR-2827, FAR-2837S

Waste disposal plant
Incinerator
Make: ..... Nanjing Luzhou
Model: OG120C
Waste compactor
Make: ..... Kang Li Far East Pte., Ltd
Model: TGSS15EX
Sewage plant
Make: ..... Wärtsilä
Model: STC02-13
Contract date: ..... 30 November 2015
Launch/float-out date: ..... 22 January 2017
Delivery date: ..... 1 June 2017

BLACK DUCK



ELANDRA EAGLE: Suezmax crude oil tanker

Shipbuilder: ..... **Sungdong Shipbuilding & Marine Engineering Co., Ltd**
Vessel's name: ..... ***Elandra Eagle***
Hull No: **S2053**
Owner/Operator: ..... **Elandra Holdings Ltd**
Country: ..... **British Virgin Islands**
Designer: ... **Sungdong Shipbuilding & Marine Engineering Co., Ltd**
Country: ..... **Republic of Korea**
Model test establishment used: ..... **KRISO**
Flag: ..... **Marshall Islands**
IMO number: **9792474**
Total number of sister ships already completed (excluding ship presented): **0**

ELANDRA EAGLE is the first vessel in a series of two Suezmax crude oil tankers built by Sungdong Shipbuilding & Marine Engineering for Elandra Holdings Ltd.

The vessel is built under the survey of Lloyd's Register of Shipping and designed in accordance with IACS Common Structure Rules. The vessel features a double side-skin and has a flush deck, bulbous bow, transom stern, open water-type stern frame, full-spade rudder and single propeller driven by a slow-speed diesel engine.

The main MAN 6G70ME-C9.5 Tier II engine is derated to 15,088kW at 71.8rpm for economy of fuel oil consumption. The speed of the vessel at scantling draft (17.15m) is 14.2knots at 71.7 percent of MCR (10,818kW), with a 15 percent sea margin based on a well-optimised hull form and propeller design which have been analysed using CFD. Electric power is generated from three diesel generators driven by a 1,050kW alternator and steam is generated by two auxiliary boilers of water tube type with a capacity of 35,000kg/h and an exhaust gas economiser with a capacity of 500kg/h.

Elandra Eagle has six pairs of cargo oil tanks, two slop tanks, fore and aft peak tanks, segregated water ballast tanks, fuel oil tanks and freshwater tanks. Cargo tanks are divided by plane-type transverse and longitudinal bulkheads. Cargo handling is performed by three steam turbine-driven cargo oil pumps capable of 4,000m^3/h. Water ballast is handled by two ballast pumps which are driven by steam turbine and electric motor. The water ballast treatment system is of the ozone type and has a capacity of 3,000 m^3/h.

The vessel takes full consideration of the latest environmental guidelines such as for fuel oil protection, Inventory of Hazardous Materials for ship's recycling, Performance Standards for Protective Coatings (PSPC) and IMO Tier II NOx requirements. The vessel also has a low-sulphur fuel oil tank to satisfy emission requirements in Sulphur Emission Control Areas (SECAs), and has an emergency response system.

TECHNICAL PARTICULARS

Length oa: ..... ca. 277.0m
Length bp: 267.0m
Breadth moulded: 48.0m
Depth moulded
  To main deck: 23.1m
Width of double skin
  Side: 2.5m
  Bottom: 2.8m
Draught
  Scantling: 17.15m
  Design: 16.0m

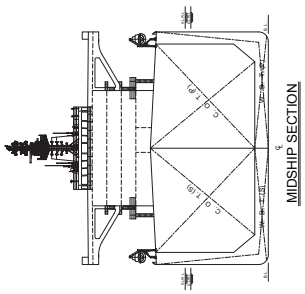
Deadweight
  Design: 144,300dwt
  Scantling: 157,300dwt
Speed, service (71.7% MCR output): 14.2knots
Cargo capacity (m^3)
  Liquid volume: 174,000
Bunkers (m^3)
  Heavy oil: 3,700
  Diesel oil: 1,000
Water ballast (m^3): 53,000
Daily fuel consumption (tonnes/day)
  Main engine only: 38.6

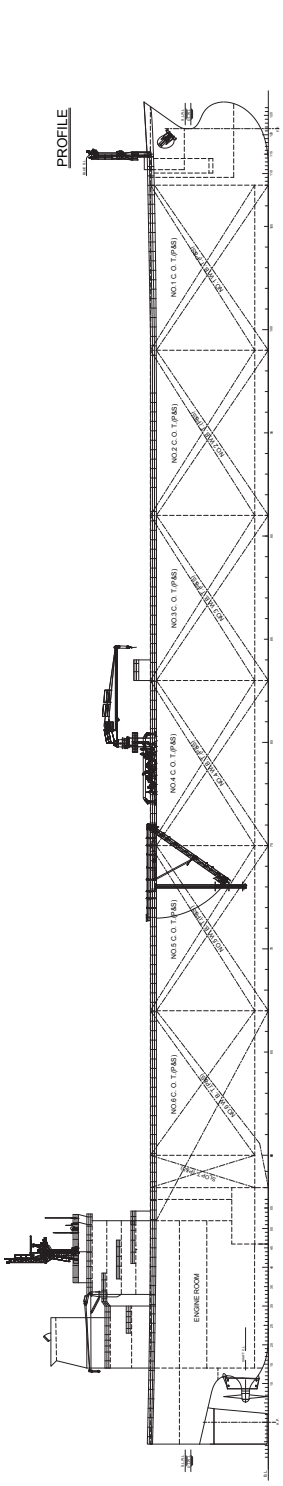
Classification society and notations: ..... LR +100A1 Double Hull Oil Tanker, CSR, ESP, ShipRight(CM, ACS(B,C)), *IWS, LI, +LMC, IGS, UMS, with descriptive notes ETA, COW(LR), ShipRight (BWMP(S,T), SERS, SCM), ECO(BWT, IHM, VECS-L, IBTS), DSPM4
Main engine
  Design: ..... MAN B&W
  Model: 6G70ME-C9.5
  Manufacturer: ..... STX
  Number: 1
  Type of fuel: ..... HFO, MDO, MGO
  Output of each engine: 15,088kW x 71.8rpm
Propeller
  Material: ..... Ni-Al-Bronze
  Designer/Manufacturer: ..... Silla Metal
  Number: 1
  Fixed/Controllable pitch: ..... Fixed
  Diameter: 9.0m
  Speed: 71.8rpm
Diesel-driven alternators
  Number: 3
  Engine make/type: ..... STX, 6L23/30H-MK2
  Type of fuel: ..... HFO, MDO, MGO
  Output/speed of each set: 1,050kW, 900rpm
Boilers
  Number: ..... 2 + 1
  Type: ..... PB0601AS18 / PC09AAP001
  Make: ..... Kangrim
  Output, each boiler: ..... 35,000kg/h / 1,800/500kg/h (oil fire/ exhaust gas)
Cargo cranes/cargo gear
  Number: 2
  Make: ..... DMC
  Type: ..... Electro-hydraulic
  Performance: ..... 20t SWL
Other cranes
  Number: ..... 1 + 2
  Make: ..... DMC
  Type: ..... electro-hydraulic
  Tasks: ..... Provisions handling
  Performance: 8t at 7.3m SWL (port) / 2t SWL (starboard)
Mooring equipment
  Number: 9
  Make: ..... MacGregor Pusnes
  Type: ..... Electro-hydraulic
Special lifesaving equipment
  Number of each and capacity: ..... 2 x 30 persons
  Make: ..... HLB
  Type: ..... Gravity-type
Cargo pumps
  Number: 3
  Type: ..... Centrifugal, vertical, single-stage
  Make: ..... Shinko
  Capacity: ..... 4,000m^3/h each
Cargo control system
  Make: ..... Emerson
  Type: ..... Piano console
Ballast control system
  Make: ..... Emerson
  Type: ..... Piano console
Water ballast treatment system
  Make: ..... Hyundai Heavy Industry
  Capacity: .. 4,000m^3/h (For W.B.TK. & F.P.TK.) + 250m^{3}h (For A.P.TK.)
Complement
  Officers: 18
  Crew: 10
  Suez/Repair Crew: 6
Bridge control system
  Make: ..... KTE
  Type: ..... Piano
  Is bridge fitted for one-man operation? ... Yes

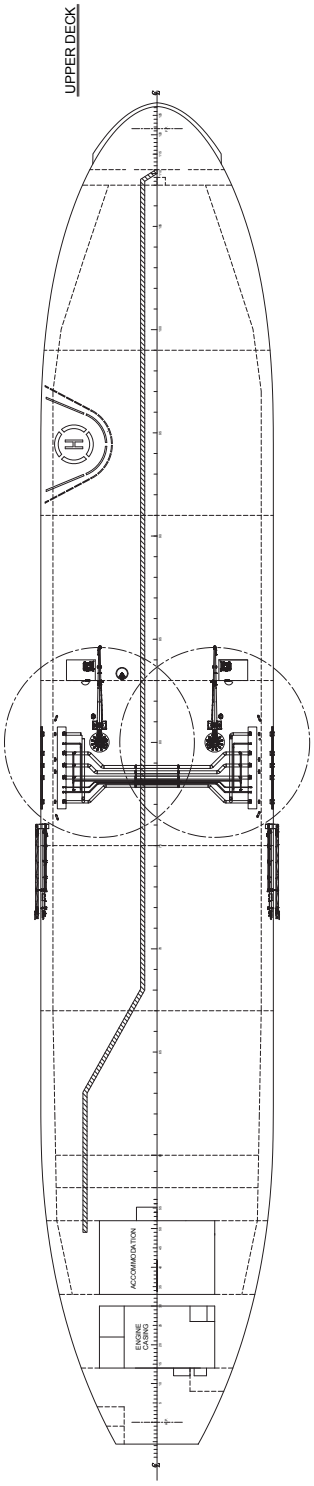
Fire detection system
  Make: ..... Autronica
  Type: ..... Address
Fire extinguishing systems
  Cargo holds:
    Make/Type: Tyco Sea Plus fixed-deck foam
  Engine room:
    Make/Type: ..... NK/Water mist & Tyco Sea Plus high-expansion foam
Radars
  Number: 2
  Make: ..... JRC
  Model(s): ..... JMR-9282-S (S-band) x 1 / JMR-9225-6X (X-band) x 1
Integrated bridge system: ..... No
Waste disposal plant
  Incinerator
    Make: ..... HMMC
    Model: ..... Maxi NG100SL WS
  Waste shredder/crusher
    Make: ..... Samjoo
    Model: BS515
  Sewage plant
    Make: ..... Il Seung
    Model: ISB-03

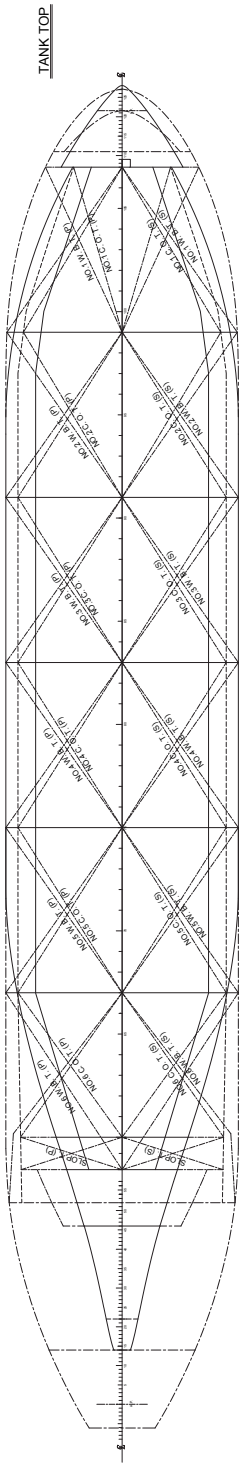
Contract date: ..... June 2015
Launch/float-out date: ..... December 2016
Delivery date: ..... April 2017

ELANDRA EAGLE









GUANG ZHOU WAN: Asphalt / oil tanker

Shipbuilder: ..... **Qing Dao Wu Han Heavy Industry Co., Ltd**
Vessel's name: ..... ***Guang Zhou Wan***
Hull No: **AH0002AL**
Owner/Operator: ..... **China COSCO Shipping Corp. Ltd**
Country: ..... **China**
Designer: . **Shanghai Merchant Ship Design & Research Institute, CSSC**
Country: ..... **China**
Model test establishment used: ..... **China Ship Scientific Research Centre**
Flag: ..... **China**
IMO number: **980578**
Total number of sister ships already completed (excluding ship presented): **1**

GUANG ZHOU WAN is a 13,000dwt asphalt/oil tanker which has been tailor-made for Chinese owner COSCO Shipping Co., Ltd. The vessel was delivered in March 2017 and in total two ships of this series – which were designed by SDARI, constructed by Qing Dao Wu Han Heavy Industry Co., Ltd and registered under CCS Class Rules – have been ordered.

Upon service entry, this series became the biggest asphalt tanker class in COSCO Shipping's fleet.

Optimal fuel efficiency is its most significant feature. The hull form was based on organic integration of SDARI's empirical method and numerical towing tank technology. An efficient bow ensures better sea-keeping performance and reduces speed loss in rough seas. Verification through model testing by the China Ship Scientific Research Center has resulted in a hull form which has been optimised to achieve maximum energy efficiency over the range of speeds and draughts likely to be encountered in service.

Guang Zhou Wan is designed to carry bitumen (to a maximum cargo temperature ≤200°C) and product oil (flash point >60°C) in four independent cargo blocks. Each block is divided into two cargo holds. The main hull structure is of double hull and single bottom in order to fit the independent cargo blocks. The cargo is heated with thermal oil through two separate loop-heating coils inside the cargo tanks, and the cargo temperature can be controlled individually. The blocks are externally insulated by ceramic wool.

The vessel has been designed to offer an improved environmental footprint and *Guang Zhou Wan*'s EEDI value satisfies Phase II of the IMO's regulations. A water-lubricated shaft bearing system is used to avoid potential oil leakage.

TECHNICAL PARTICULARS

Length oa: 145.9m
Length bp: 138.0m
Breadth moulded: ..... 22.6 m
Depth moulded
  To main deck: 11.80m
  To upper deck: 11.80m
Width of double skin
  Side: 1.70m
Draught
  Scantling: 7.90m
Gross: 11,081t
Displacement: 19,800gt
Lightweight: 6,500t
Deadweight
  Scantling: 13,300dwt
Block co-efficient (please state relevant draught): ..... 0.7837 at scantling draught
Speed, service: 14.0knots at design draught, at 0.85 CMCR
Cargo capacity (m^3)
  Liquid volume: 12,800
Bunkers (m^3)
  Heavy oil: 900
  Diesel oil: 270
Water ballast (m^3): 4,900
Daily fuel consumption (tonnes/day)
  Main engine only: 14.8
Classification society and notations: ..... CCS
  ★CSA Asphalt Carrier / Oil Tanker, Independent tank Maximum Cargo Temperature • 200 C, F.P.>60 C, Double Hull; PSPC(B); Loading Computer(S,I,D); In-Water Survey; BWMP(MEPC.127(53))
  ★CSM AUT-0, SCM; VCS; Clean, GPR, FTP

% high-tensile steel used in construction: ca. 30

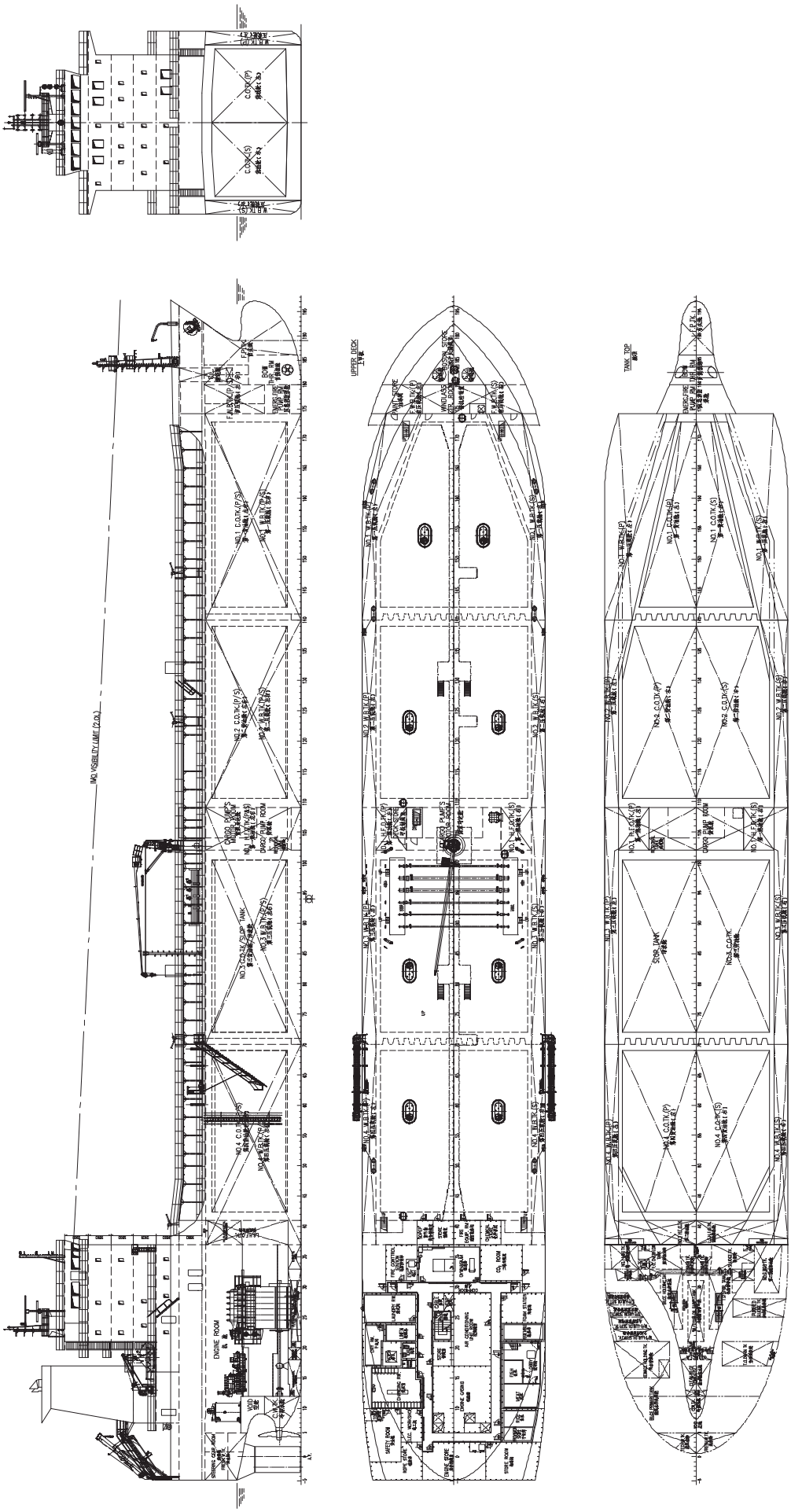
Heel control equipment: ..... Anti-heeling system
Main engine
  Design: ..... MAN B&W
  Model: 6S40ME-B9.5
  Manufacturer: . Dalian Marine Diesel Co., Ltd
  Number: 1
  Type of fuel: ..... HFO & MDO & MGO
  Output of each engine: . 4,320kW x 111r/min
Propeller
  Material: ..... Ni-Al-Bronze
  Designer/Manufacturer: ..... Shanghai Marine Propeller Design Co., Ltd
  Number: 1
  Fixed/Controllable pitch: ..... Fixed
  Diameter: 5.20m
  Speed: 14.0kt
Diesel-driven alternators
  Number: 3
  Engine make/type: ..... Wärtsilä Qiyao Diesel Company Ltd / 645W4L20
  Type of fuel: .. HFO & ULSFO & MDO & MGO
  Output/speed of each set: . 680kW x 900rpm
  Alternator make/type: ..... CSIC / 1FC6 506-8SA83
  Output/speed of each set: . 645kW x 900rpm

Boilers
  Number: ..... 2+1+2
  Type: RMS 8/2Z x2 + EXV5-40-60-57-800DD x1 + EXV3-25-29-33.7-500DD x2
  Make: ..... Alfa-Laval
  Output, each boiler: ...2000kW x 2 +550kW x 1+ 140kW x2
Cargo cranes/cargo gear
  Number: 1
  Make: ..... Shanghai Hengyuan
  Type: ..... Single-jib, cylinder-luffing and slewing crane
  Performance: ..... 5t x 16m SWL
Other cranes
  Number: 1
  Type: .... gravity single-arm, electric-hydraulic driven, explosion-proof auxiliary
  Tasks: ..... lifting engine room parts
  Performance: ..... 2t x 4m SWL
Mooring equipment
  Number: 4
  Make: ..... Wuhan Marine Machinery
  Type: ..... Electric
Special lifesaving equipment
  Number of each and capacity: ..... 1 x 23 persons
  Make: ... Jiangyin Neptune Marine Appliance Co., Ltd
  Type: ..... Fully enclosed free-fall
Hatch covers
  Design: ..... Nanjing Haixu
  Manufacturer: ..... Nanjing Haixu
  Type: ..... Upper deck
Water ballast treatment system
  Make: ..... COSCO (WeiHai) Shipbuilding Marine Technology Co. Ltd
  Capacity: ..... 500m^3/h × 2
Complement
  Officers: 14
  Crew: 13
  Suez/Repair Crew: 6
Bow thruster(s)
  Make: ..... Schottel
  Number: 1
  Output: 550kW
Bridge control system
  Make: ..... Furuno
  Is bridge fitted for one-man operation? .... No

Fire detection system
  Make: ..... Consilium
  Type: ..... Salwico Cargo
Fire extinguishing systems
  Cargo holds: ..... CO_2
    Make: ..... NK (NK Co., Ltd)
  Engine room: ..... CO_2
    Make: ..... NK (NK Co., Ltd)
Radars
  Number: 2
  Make: ..... JRC
  Models: ..... JMR-9230-S3 /JMR-9225-9X3
Waste disposal plant
  Incinerator
    Make: ..... Hansun(Shanghai) Marine Technology Co. Ltd.
    Model: HSINC-50A
  Sewage plant
    Make: ..... Hansun(Shanghai) Marine Technology Co. Ltd
    Model: ST-30U

Contract date: ..... December 2014
Launch/float-out date: ..... 29 December 2015
Delivery date: ..... 20 March 2017

GUANG ZHOU WAN



OTTOMAN COURTESY: Crude oil tanker

Shipbuilder: ..... **Hyundai Heavy Industries**
Vessel's name: ..... ***Ottoman Courtesy***
Hull No: **2886**
Owner/Operator: ..... **Gungen**
Country: ..... **Turkey**
Designer: ..... **Hyundai Heavy Industries**
Country: ..... **Republic of Korea**
Model test establishment used: ..... **Hyundai Maritime Research Institute (HMRI)**
Flag: ..... **Turkey**
IMO number: **9788710**
Total number of sister ships already completed (excluding ship presented): **0**

OTTOMAN COURTESY is a 153,000dwt crude oil carrier. Built by Hyundai Heavy Industries for Gungen, the vessel was delivered in August 2017.

The design is intended to reduce energy requirements and emissions, having been fitted with the latest in energy-saving features. For instance, the boiler's fuel consumption is minimised by applying Economiser Energy Control (EEC), which can increase steam production in with only small amounts of additional fuel.

The vessel has an overall length of 269m, a width of 46m and a depth 25.1m, with a design draft of 16.2m. It has six pairs of cargo oil tanks and one pair of slop tanks. To handle the cargo the vessel is fitted with three vertical, centrifugal, single stage-type HHI pumps of 4,000m^3/h capacity each. There are six pairs of water ballast tanks with a double hull structure combined with a double bottom. The ballast water treatment system is of the electrolysis type and is supplied by Hyundai.

Ottoman Courtesy is propelled by one main engine with an MCR of 13,900kW, which enables it to sail at a service speed of 13.5kt at design draft. When running at normal continuous rating with a 15 percent sea margin, the vessel burns less fuel at around 34.7 ton per day.

The vessel has been built according to the latest SOLAS/MARPOL requirements, is EEDI Tier II compliant and CSR harmonised.

TECHNICAL PARTICULARS

Length oa: 269.08m
Length bp: 258m
Breadth moulded: 46m

Depth moulded
To main deck: 25.1m

Draught
Scantling: 17.8m
Design: 16.2m

Gross: 83,537gt
Deadweight
Scantling: 149,999dwt

Speed, service: 13knots

Cargo capacity (m^3)
Liquid volume: ..... ca. 178,500

Bunkers (m^3)
Heavy oil: ..... ca. 3,250
Diesel oil: ..... ca. 600

Water ballast (m^3): ..... ca. 50,000

Classification society and notations: ..... DNV GL +1A1, Tanker for Oil ESP, CSR, E0, SPM, VCS-2B, BIS, CCO, TMON, CLEAN, OPP-F, BWM-E(s,f), BWM-T, COAT-PSPC(B,C), ECA(SOx-A), Recyclable

Main engine
Design: ..... Two-stroke marine diesel
Model: 5G70ME-C9.5
Manufacturer: ..... Hyundai-MAN B&W
Number: 1
Type of fuel: ..... HFO or MGO
Output: ..... 13,900kW (MCR)

Propeller
Material: ..... Ni-Al-Bronze
Designer/Manufacturer: ..... HHI
Number: 1
Fixed/Controllable pitch: ..... Fixed
Diameter: ..... 8.6 m
Speed: ..... 75.3 rpm

Diesel-driven alternators
Number: 3
Engine make/type: ..... Hyundai 7H21/32
Type of fuel: ..... HFO or MGO
Output/speed of each set: 1,520kW x 90 rpm
Alternator make/type: ..... Hyundai
Output/speed of each set: ..... 1,420kW x 900rpm

Boilers
Number: 2
Type: ...Automatic, forced draft, heavy fuel oil burning, marine
Make: ..... Alfa Laval
Output, each: ..... 35,000 kg/h

Cargo cranes/cargo gear: ..... Hose handling crane
Number: 2
Make: ..... Oriental Precision
Type: ..... Electro-hydraulic
Performance: ..... 20t SWL

Other cranes
Number: 2
Make: ..... Oriental Precision
Type: ..... Electro-hydraulic
Tasks: ..... Provision crane
Performance: ..... 8t SWL (port) / 2t SWL (s'bd)

Mooring equipment
Number: ..... 2 windlass, 7 mooring winch
Make: ..... Rolls Royce Marine (Korea)
Type: ..... Electro-hydraulic

Special lifesaving equipment
Number of each and capacity: ..... 2 x 33 persons
Make: ..... Norsafe (China)
Type: ..... Conventional

Cargo pumps
Number: 3
Type: ..... Vertical centrifugal, steam turbine-driven
Make: ..... Shinko
Capacity (each): ..... 4,000 m^3/h x 135mTH

Cargo control system
Make: ..... Kongsberg
Type: ..... Computerised control and monitoring system

Ballast control system
Make: ..... Kongsberg
Type: ..... Computerised control and monitoring system

Water ballast treatment system
Make: ..... Hyundai HiBallast
Capacity: ..... 5,740 m^3/h

Complement
Officers: 13
Crew: 20
Suez/Repair Crew: ..... 1 cabin for 6 Suez crew

Bridge control system
Make: ..... Kongsberg
Type: ..... Auto Chief 600
Is bridge fitted for one-man operation? ...Yes

Fire detection system
Make: ..... Consilium
Type: ..... Salwico Cargo (Addressable)

Fire extinguishing systems
Cargo holds: ..... Deck foam
Make/Type: ..... NK

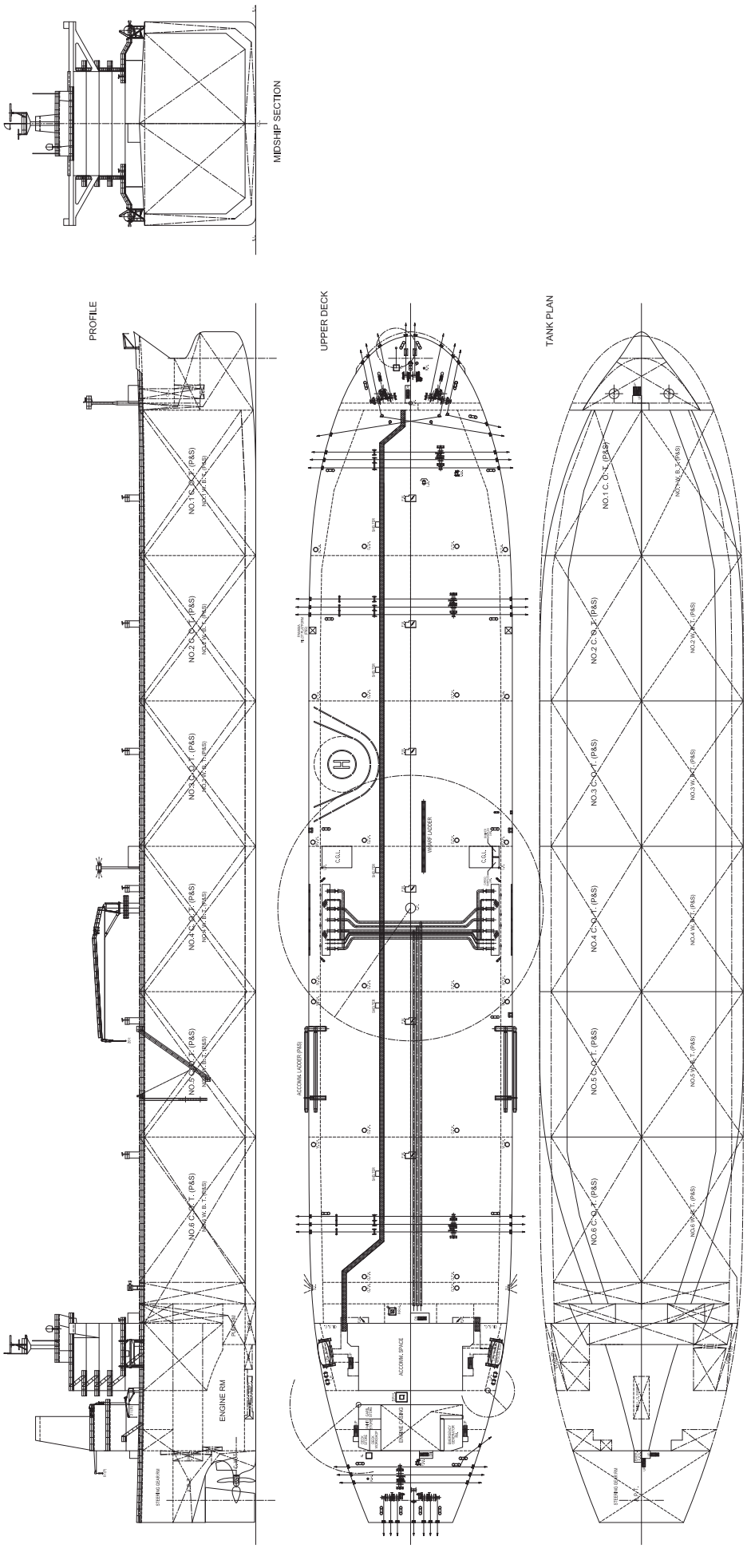
Engine room: ..... High-pressure CO_2
Make: ..... NK

Radars
Number: ..... 2 (1 x S-band, 1 x X-band)
Make: ..... JRC
Models: ..... JMR-9282-S (S-band) / JMR-9225-6X (X-band)

Integrated bridge system: ..... Yes
Make: ..... JRC
Model: JAN-9201

Contract date: ..... September 2015
Delivery date: ..... 16 August 2017

OTTOMAN COURTESY



V.TRUST: Crude oil tanker

Shipbuilder: ..... **Hyundai Heavy Industries**
Vessel's name: ..... ***V.Trust***
Hull No: **2910**
Owner/Operator: ..... **Oriental Shipping**
Country: ..... **Hong Kong, China**
Designer: ..... **Hyundai Heavy Industries**
Country: ..... **Republic of Korea**
Flag: ..... **Panama**
IMO number: **9794812**
Total number of sister ships already completed (excluding ship presented): **1**

V.TRUST is a 300,000dwt crude oil tanker. Built by Hyundai Heavy Industries Co., Ltd (HHI), it was delivered to Oriental Shipping in August 2017.

The vessel has an overall length of 336m, a width of 60m, a depth of 29.4m and a design draught of 21.7m. There are 17 cargo oil tanks, including two slop tanks, with total capacity of 345,000m^3. Five pairs of water ballast tanks combine with a double bottom to form a double hull structure. *V.Trust* has been built according to the latest SOLAS/MARPOL requirements and also meets the IACS's new harmonised Common Structural Rules (New CSR) and enhanced EEDI minimum power requirements.

The design maximises efficiency by reducing fuel consumption. HHI used a Hi-PSD (Hyundai Preswirl Duct) and the newly developed Hi-Bow bow shape. The Hi-Bow has a sharpened bow shape above the waterline. By comparison with a conventional blunt bulbous bow it reduces the added wave resistance in rough seas. Sea-keeping performance in heavy weather conditions is improved without degrading calm sea performance.

TECHNICAL PARTICULARS

Length oa: abt.336m
Length bp: 330m
Breadth moulded: 60m

Depth moulded
To main deck: 29.4m
Draught
Scantling: 21.7m
Design: 20.5m
Deadweight
Scantling: 301,100dwt

Speed, service: 15.8knots
Cargo capacity (m^3)
Liquid volume: ..... ca. 345,000
Bunkers (m^3)
Heavy oil: ..... ca. 5,750
Diesel oil: ..... ca. 450
Water ballast (m^3): ..... ca. 90,000

Classification society and notations ..... KR: +KRS1-Oil Tanker (Double Hull) 'ESP', (FBC), (CSR), Crude Seatrust(HCM), VEC-2, IGS, COW, CLEAN1, IWS, BWT, LI, EQ-SPM, +KRM1-UMA, STCM, PSPC, ERS
LR: +100A1 Double hull oil tanker, CSR, ESP, ShipRight (CM, ACS(B,C)), *IWS, LI, DSPM4, +LMC, UMS, IGS, ShipRight (SCM, BWMP(T))

Main engine
Model: 7X82
Manufacturer: ..... Hyundai-Wärtsilä
Number: 1
Type of fuel: ..... HFO or MGO
Output of each engine: .. 25,600 kW x 67rpm

Propeller
Material: ..... Ni-Al-Bronze
Designer/Manufacturer: ..... Hyundai
Number: 1
Fixed/Controllable pitch: ..... Fixed
Diameter: ..... 10.6 m

Diesel-driven alternators
Number: 3
Engine make/type: ..... Hyundai, Himsen 6H21/32
Type of fuel: ..... HFO or MGO
Output/speed of each set: 1,280kW x 90 rpm
Alternator make/type: ..... Hyundai
Output/speed of each set: ..... 1,200kW x 900rpm

Boilers
Number: 2
Type: ..... Cylindrical
Make: ..... Alfa Laval
Output, each boiler: 40,000kg/h
Cargo cranes/cargo gear: Hose-handling crane
Number: 2
Make: ..... Oriental Precision
Type: ..... Electro-hydraulic
Performance: ..... 25t SWL
Other cranes
Number: 2
Make: ..... Oriental Precision
Type: ..... Electro-hydraulic
Tasks: ..... Provision crane
Performance: ..... 10t SWL (port) / 3t SWL (starboard)
Mooring equipment
Number: ... 2 windlasses, 8 mooring winches
Make: ..... Flutek
Type: ..... Electro-hydraulic

Special lifesaving equipment
Number of each and capacity: ..... 2, 35 persons each
Make: ..... HLB (Hyundai Lifeboat)
Type: ..... Conventional

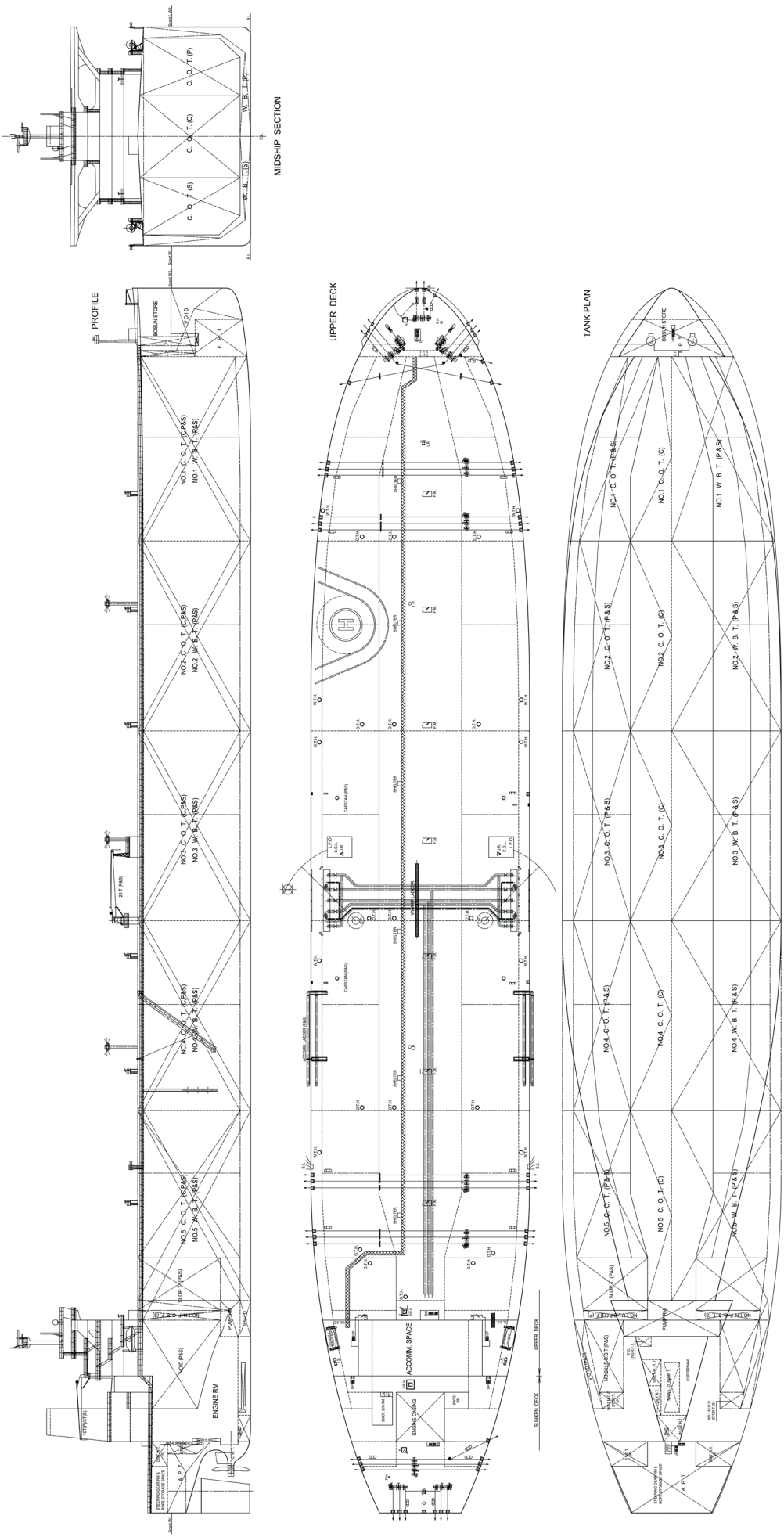
Cargo tanks
Number: ..... 15 + 2 slop
Grades of cargo carried: 3
Product range: ..... Crude oil
Cargo pumps
Number: 3
Type: ..... Vertical centrifugal, steam turbine-driven
Make: ..... Shinko
Capacity (each): ..... 5,000m^3/h x 150mTH
Cargo control system
Make: ..... Emerson Marine
Type: ..... Conventional console control

Ballast control system
Make: ..... Emerson Marine
Type: ..... Conventional console control
Water ballast treatment system
Make: ..... Techcross
Capacity: ..... 6,360 m^3/h

Complement
Officers: 12
Crew: 18
Suez/Repair Crew: .. 1 cabin for 6 Suez crew

Bridge control system
Make: ..... Nabtesco
Type: M-800-V
Is bridge fitted for one-man operation? ...Yes

Fire detection system
Make: ..... AUTRONICA
Type: ..... AutroSafe (Addressable)
Fire extinguishing systems
Cargo holds: ..... Deck foam
Make/Type: ..... NK
Engine room: ..... High-pressure CO_2
Make/Type: ..... NK
Radars
Number: 2
Make: ..... JRC
Models: ..... JMR-9282-S for S-band / JMR-9225-6X for X-band
Integrated bridge system: ..... Yes
Make: ..... JRC
Model: JAN-9201
Delivery date: ..... 31 August 2017


MIDSHIP SECTION
PROFILE
UPPER DECK
TANK PLAN
ENGINE RM
ACCOMM. SPACE
ENGINE CASING
SUNKEN DECK
UPPER DECK

ALMI ATLAS: Very large crude carrier

Shipbuilder: ..... **Hyundai Samho Heavy Industries Co. Ltd.**
Vessel's name: ..... ***Almi Atlas***
Hull No: **S913**
Owner/Operator: ..... **Almi Tankers**
Country: ..... **Greece**
Designer: ..... **Hyundai Samho Heavy Industries Co. Ltd.**
Country: ..... **Republic of Korea**
Model test establishment used: ..... **Hyundai Maritime Research Institute**
Flag: ..... **Liberia**
IMO number: **9816323**
Total number of sister ships already completed (excluding ship presented): **1**
Total number of sister ships still on order: ..... **nil**

Delivered in March 2018, *Almi Atlas* is one of the earliest vessels in this edition of Significant Ships, but planning for her and her sister *Almi Titan*'s (delivered in June 2018) environmental credentials began almost two years previously when the pair were ordered from Hyundai Samho Heavy Industries.

The most obvious deviation from the usual VLCC profile is the large casing behind the stack of the vessel. This is necessary as the 315,221dwt ship features an Alfa Laval PureSOx ECA Open Loop U-type exhaust gas cleaning system underlining the owner's foresight in preparing for the 2020 sulphur cap some time before the surge of scrubber ordering in earnest began last year.

In fact the vessel is the first VLCC to feature a scrubber and is therefore a trailblazer for the technology – even more so considering that the vessel was ordered just weeks after the IMO decision to opt for a 2020 date. At the time of ordering, the competitive advantage that scrubbers are expected to deliver was less anticipated than it is now.

The scrubber fitted treats the exhaust from both main and auxiliary engines allowing the ship to operate full time on HFO as desired. Among other eco-friendly technologies on board, the vessel is also equipped with the Hyundai HiBallast HiB 6000ex Ballast Water Treatment System.

Almi Atlas features a Hyundai-built B&W 7G80ME - C9.5 - EGRTC (Tier III) engine – she is one of the first vessels of her size with a Tier III engine and the order for it in 2016 marked the 1500th order for MAN's G-series engines. The auxiliary engines are a trio of Hyundai's in-house engine division's Himsen 9H21/32 units. The EGRTC suffix for the main engine fitted to the *Almi Atlas* indicates that it is fitted for exhaust gas recirculation in order to meet IMO NOx Tier III emissions, and also features a turbocharger cut-out.

The G-type is an ultra-long stroke engine, which, in conjunction with a larger diameter propeller, offers significant fuel savings and produces less emissions than engines with the same output, thus classifying it as one of the most environmentally efficient propulsion systems.

Almi Atlas flies the Liberian flag and is classed by DNV GL.

TECHNICAL PARTICULARS

Length oa: 336.08m
Length bp: 330m
Breadth moulded: 60m
Depth moulded
To upper deck: 30.3m
Width of double skin
Side: 3.0m
Bottom: 2.9m
Draught
Scantling: 22.6m
Design: 21m
Gross: 162,306gt
Displacement: 138,911t
Lightweight: 46,974t
Deadweight
Design: 286,489dwt
Scantling: 315,221dwt
Block co-efficient: 0.7063

Speed, service: .... 15.2knots at design draught

Cargo capacity
Liquid volume: ..... 357,777.8m^3
Bunkers
Heavy oil: ..... 4,609.2m^3
Diesel oil: ..... 1,002.7m^3
Water ballast: ..... 93,901.6m^3
Daily fuel consumption (tonnes/day)
Main engine only: .....169.59 g/kW·hr (MCR)

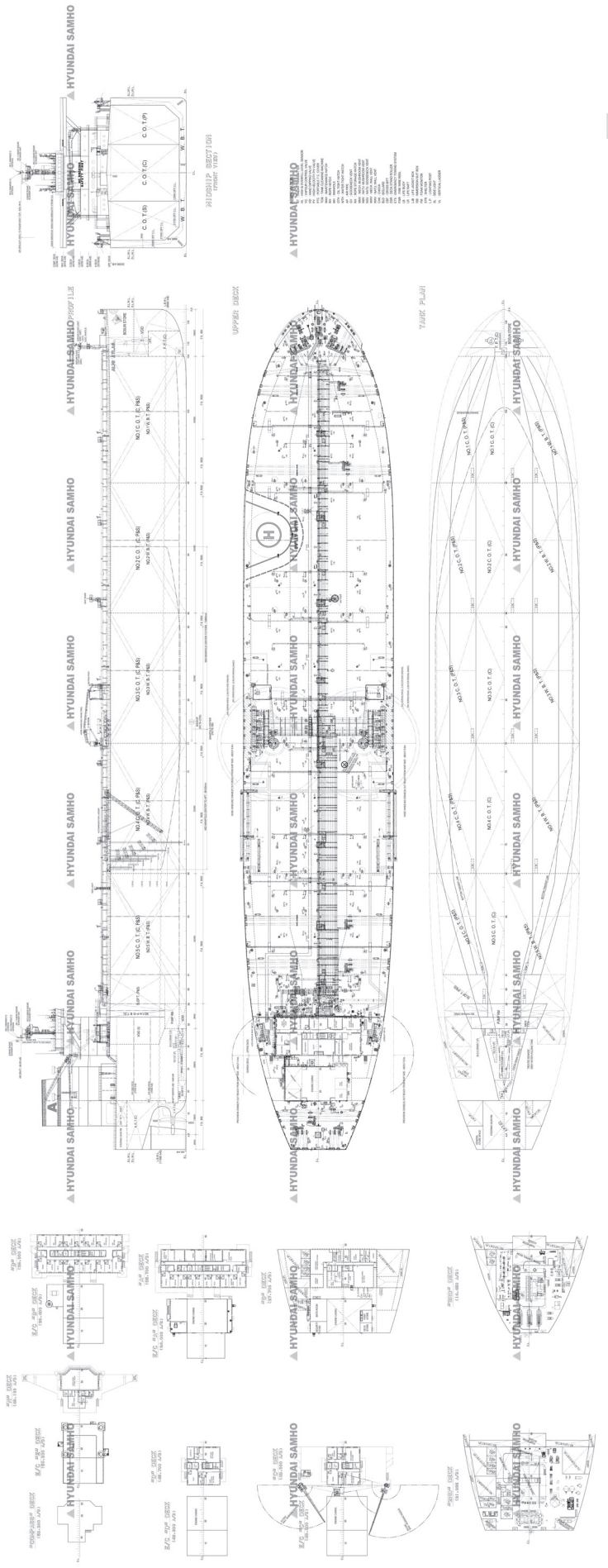
Classification society and notations: ..... DNVGL ✠1A1, Tanker for oil, BIS, BWM (T, E(S)), CLEAN, COAT-PSPC (B, C), CSA (FLS1), CSR, E0, ESP, NAUT (OC), Recyclable, SPM, TMON (oil lubricated), VCS (2B)

% high-tensile steel used in construction: 49.8%
Main engines
Design: .....Hyundai-B&W
Model: 7G80ME-C9.5-EGRTC
Manufacturer: ..... Hyundai Heavy Industries Co., Ltd, Engine & Machinery Division
Number: 1
Type of fuel: .....HFO
Output of each engine: 26,000kW
Propellers
Material: .....Ni-Al-Bronze
Designer/Manufacturer: .....Hyundai Heavy Industries Co., Ltd, Engine & Machinery Division
Number: 1
Fixed/controllable pitch: ..... Fixed
Diameter: 10.5m
Diesel-driven alternators
Number: 3
Engine make/type: .....Hyundai Heavy Industries Co., Ltd, Engine & Machinery Division / Himsen 9H21/32
Type of fuel: .....HFO
Output/speed of each set: ..... 1,940kW / 900rpm
Alternator make/type: .....Hyundai Electric & Energy Systems Co., Ltd / HFC7 638-8P
Output/speed of each set: ..... 1,830kW / 900rpm
Exhaust-gas scrubbing equipment
Manufacturer: ..... Alfa Laval Nijmegen B.V.
Type: ..... PureSOx ECA Open Loop U-type system
On main engines: .....Yes
On auxiliary engines: .....Yes
Boilers
Number: 3
Type: ..... MAC-45B x 2 / Aalborg OC-TCi x 1
Make: .....Mitsubishi Heavy Industries Co., Ltd / Alfa Laval
Output, each boiler: ..... 45,000kg/hr x 2 / 4,400kg/hr x 1
Cargo cranes/cargo gear
Number: 2
Make: .....Dongnam Marine Crane Co., Ltd.
Type: ..... Electro-hydraulic
Performance: .....20t SWL
Other cranes
Number: 2
Make: .....Dongnam Marine Crane Co., Ltd.
Type: ..... Electro-hydraulic
Tasks: .....Provision crane
Performance: ..... 10t, 3t SWL
Other cranes
Number: 1
Make: .....Dongnam Marine Crane Co., Ltd.
Type: .....Electro-magnetic
Tasks: .....Engine room crane
Performance: ..... 10t SWL
Mooring equipment
Number: 10
Make: ..... Rolls-Royce
Type: .....Hydraulic

Special lifesaving equipment
Number of each and capacity: ..... 2 / 36 persons
Make: ..... Hyundai Lifeboats Co., Ltd.
Type: ..... Totally enclosed
Cargo tanks
Number: 17
Grades of cargo carried: .....Crude oil
Coated tanks: ....Hempel / Hempadur XO 17870
Cargo pumps
Number: 3
Type: KV450-4
Make: .....Shinko Industries Ltd.
Capacity: ..... 5,000m^3/h each
Cargo control system
Make: .....KSB Seil Co., Ltd.
Type: ..... Electro-hydraulic remote control
Ballast control system
Make: .....KSB Seil Co., Ltd.
Type: .....Hydraulic and remote control
Water Ballast Treatment System
Make: .... Hyundai Heavy Industries Co., Ltd, Engine & Machinery Division
Capacity: ..... 6,000m^3/h
Complement
Officers: 14
Crew: 22
Stern appendages/special rudders: .. Half Duct
Bridge control system
Make: ....Hyundai Electric & Energy Systems Co., Ltd.
Type: ..... Console
One-man operation: .....Yes

Radars
Number: 2
Make: ..... JRC
Model: JMR-9225-6X
Integrated bridge system: .....No
Contract date: .....3 August 2016
Launch/float-out date: ..... 30 December 2017
Delivery date: ..... 13 March 2018

ALMI ATLAS



AMPHION: Very large crude carrier

Shipbuilder: .....**Samsung Heavy Industries Co., Ltd.**
Vessel's name: .....***Amphion***
Hull No: **SN2225**
Owner/Operator: ..... **CVLC One Carrier Corp.**
Country: .....**Greece**
Designer: .....**Samsung Heavy Industries Co., Ltd.**
Country: .....**Republic of Korea**
Model test establishment used: **Samsung Ship Model Basin**
Flag: ..... **Liberia**
IMO number: **9830795**
Total number of sister ships already completed (excluding ship presented): ..... **nil**
Total number of sister ships still on order: **3**

Completed in late 2018, *Amphion* was handed over by Samsung Heavy Industries to its owners Capital Maritime early in January 2019. The 320,784dwt VLCC is the first of four ships delivered under a contract signed in May 2017 which includes the option of four further vessels.

The ship is described by its owner as an eco-type VLCC crude oil tanker in line with the company's long term ambition which has seen it win many environmental industry awards. In 2009, Capital developed a plan that commits the business to reduce GHG emissions by 30% on a 2009 baseline over an 11-year period until 2020. The company has sought to further improve its energy efficiency through active voyage management, including weather routing and speed optimisation. It has also been an enthusiastic supporter of the OCIMF 'virtual arrival' concept.

Samsung, the designer and builder of the vessel, describe it as a fuel-efficient and technically advanced crude oil tanker. The new vessel is fitted with an electronically controlled MAN B&W 7G80ME-C9 two-stroke engine producing 26,890kW at 72rpm and driving a fixed-pitch propeller to give a service speed of 13knots.

The vessel also features significant improvements in hull design, which increase fuel efficiency. From the growing list of the various Samsung in-house energy saving devices, *Amphion* is fitted with the SAVER fin for directing flow along the hull to the propeller, the SAVER Stator located directly in front of the propeller which optimises the flow, STAR (Samsung Tip Advanced Rake) propeller and SARB (Samsung Asymmetric Rudder Bulb). Between them these devices reduce fuel consumption by a claimed 6%. To allow the ship to run on HFO after the 2020 sulphur cap kicks in, the ship is scrubber ready.

The cargo tank configuration is standard for a VLCC comprising five each of port side, centre and starboard side tanks for a total of 15 tanks along with a port and starboard slop tank. There are three cargo pumps each with a 5,000m^3/h capacity.

TECHNICAL PARTICULARS

Length oa: 333m
Length bp: 326.4m
Breadth moulded: 60m
Depth moulded
to upper deck: 30.5m

Draught
Scantling: 22.8m
Gross: 191,683gt
Deadweight
Scantling: 320,784dwt

Speed, service: 14.5knots

Cargo capacity
Liquid volume: ..... 360,000m^3
Bunkers
Heavy oil: ..... 6,000m^3
Diesel oil: ..... 1,000m^3
Water ballast: ..... 96,000m^3
Tankers - percentage segregated ballast: 100%

Classification society and notations: ..... ABS A1, Oil Carrier, ESP, AMS, ACCU, CSR, CPS, RRDA, IHM, POT, BWE, SPMA, UWILD, CRC(I), ENVIRO , TCM, BWT, VEC, PORT, NBL Unrestricted Service

Main engines
Model: .....MAN B&W 7G80ME-C9.5
Manufacturer: ..... MAN Diesel
Number: 1
Type of fuel: ..... HFO or MDO
Propellers
Material: .....Ni-Al-Bronze
Number: 1
Fixed/controllable pitch: ..... Fixed
Diesel-driven alternators
Number: 3
Type of fuel: ..... HFO or MDO
Boilers
Number: 2
Type: .....Oil fired
Cargo cranes/cargo gear
Number: 2
Type: ..... Electro-hydraulic with Jib rest

Other cranes
Number: 2
Type: ..... Electro-hydraulic with Jib rest
Tasks: ..... Provision & equipment handling

Mooring equipment
Number: 10
Type: ..... Electro-hydraulic driven (high pressure)

Special lifesaving equipment
Number: 2
Type: Totally enclosed / Gravity type lifeboat

Cargo tanks
Number: 15
Grades of cargo carried: .....Crude oil

Cargo pumps
Number: 3
Type: ..... Centrifugal, Steam turbine driven

Water Ballast Treatment System: .....Applied

Complement
Officers: 11
Crew: 19
Suez/Repair Crew: 6

Bridge control system
One-man operation: .....Yes

Fire detection system
Make: ..... Consilium
Type: ..... Salwico Fire Alarm System CCP

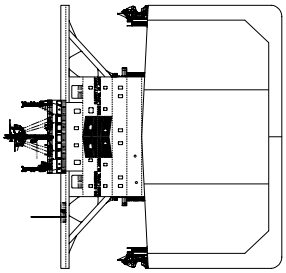
Fire extinguishing systems
Engine room:
Type: .....High expansion form
Cabins:
Type: ..... Fire hydrants
Public spaces:
Type: ..... Fire hydrants

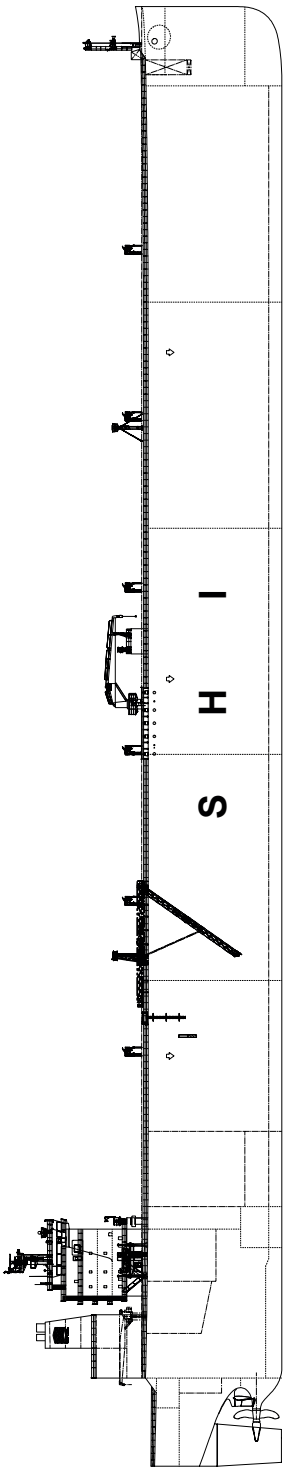
Radars
Number: .....2 sets

Waste disposal plant
Incinerator: ..... Applied
Sewage plant
Type: ..... Biological

Contract date: ..... May 2017
Delivery date: ..... 13 January 2019

AMPHION





DHT BRONCO: Very large crude carrier

Shipbuilder: ..... **Hyundai Heavy Industries**
Vessel's name: ..... ***DHT Bronco***
Hull No: **2957**
Owner/Operator: ..... **DHT**
Country: ..... **Norway**
Designer: ..... **Hyundai Heavy Industries**
Country: ..... **Republic of Korea**
Flag: ..... **Hong Kong**
IMO number: **9822994**
Total number of sister ships already completed (excluding ship presented): **1**
Total number of sister ships still on order: ..... **nil**

Hyundai Heavy Industries' first order of 2017 was for a pair of 319,000dwt VLCCs from DHT Holdings. The two vessels of which *DHT Bronco* was the first delivered are built to a Hyundai Heavy Industries design with a number of proprietary energy saving features.

DHT has decided on scrubbers as the solution to the 2020 sulphur cap and while most vessels in the DHT fleet are still to be retrofitted, *DHT Bronco* and its sister *DHT Mustang* were each delivered with an Alfa Laval PureSOx system installed. The scrubber treats exhausts from the main engine, auxiliary engines and the boilers. In case of scrubber failure the ship has a low-sulphur MGO tank. The ship's ballast treatment system is a 6,000m^3/h Hyundai HiBallast which achieved US Coast Guard type-approval in October 2018 three months after *DHT Bronco* was delivered.

The main engine is a Hyundai-built MAN B&W 7G80ME-C9.5-HPSCR rated at 32,970kW at 72rpm. To meet NOx Tier III rules the engine – as the HPSCR suffix shows – is fitted with a high-pressure selective catalyst reduction system. The auxiliaries are a pair of HiMSEN 7H21/32, with an output of 1490kW at 900rpm.

To maximise the ship's fuel efficiency, the hull features a Hyundai Hi-Bow design which effectively reduces resistance in waves. At the aft of the ship the Hi-PSD propeller swirl duct generates additional thrust and compensates for propeller rotational energy losses by the pre-swirl flow in front of the propeller. The resulting uneven wake distribution to the propeller plane can also reduce the levels of hull vibration and propeller cavitation.

The cargo tank layout of 12 tanks – five centre tanks, five tanks on each side and two slop tanks – is a typical VLCC configuration. The tank coatings are Jotun's Jotacote Universal N10 epoxy paint over a standard primer. The cargo pumps supplied by Shinko Industries are rated at 5,000m^3/hour, with two sets of cargo eductors running at 600m^3. The pumps give *DHT Bronco* a maximum loading capacity of 20,500m^3/hour and a discharge rate of 15,000m^3/hour.

TECHNICAL PARTICULARS

Length oa: 333m
Length bp: 327m

Breadth moulded: 60m

Depth moulded
To main deck: 30.4m

Draught
Scantling: 22.6m
Design: 21m

Deadweight
Scantling: 317,975dwt

Speed, service: 14.8knots

Cargo capacity
Liquid volume: ..... 353,900m^3

Bunkers
Heavy oil: ..... 5,500m^3
Diesel oil: ..... 1,200m^3

Water ballast: ..... 91,600m^3

Classification society and notations: ..... ABS +A1(E), Oil Carrier, +AMS, +ACCU, ESP, CSR, AB-CM, UWILD, TCM, SPMA, CPS, VEC, BWE, BWT, RW, ENVIRO+, POT, IHM, NBLES, DWA

Main engine:
Model: 7G80ME-C9.5-HPSCR
Manufacturer: ..... Hyundai-MAN B&W
Number: 1
Type of fuel : ..... HFO or MGO
Output of each engine: ..... 24,500kW x 66.1rpm

Propeller(s)
Material: ..... Ni-Al-Bronze
Designer/Manufacturer: ..... Hyundai
Number: 1
Fixed/Controllable pitch: ..... Fixed
Diameter: 10.4m

Diesel-driven alternators
Number: 3
Engine make/type: ..... Hyundai, HiMSEN 7H21/32
Type of fuel: ..... HFO or MGO
Output/speed of each set: ..... 1,400kW x 900rpm

Alternator make/type: ..... Hyundai
Output/speed of each set: ... 1,400kW x 900rpm

Exhaust-gas scrubbing equipment:
Manufacturer: ..... Alfa Laval
Type: ..... Open loop

Boilers
Number: 2
Type: ..... standard Vertical two-drum
Make: ..... Alfa Laval
Output, each boiler: 40,000kg/h

Cargo cranes/cargo gear: .. Hose handling crane
Number: 2
Make: ..... Oriental Precision
Type: ..... Electro-hydraulic
Performance: ..... 20t SWL

Other cranes
Number: 2
Make: ..... Oriental Precision
Type: ..... Electro-hydraulic
Tasks: ..... Provision handling crane
Performance: ..... 10t SWL (port) / 3t SWL (stbd)

Mooring equipment
Number: ..... 2 windlass, 1 SPM winch, 8 mooring winch
Make: ..... MacGregor
Type: ..... Electro-hydraulic

Special lifesaving equipment
Number of each and capacity: ..... 2x 30 persons each
Make: ..... Hyundai Lifeboat
Type: ..... Conventional

Cargo tanks
Number: ..... COT-15EA / SLOP-2EA
Grades of cargo carried: 3
Product range: ..... Crude oil

Cargo pumps
Number: 3
Type: ..... Vertical, Centrifugal, Steam turbine driven
Make: ..... Shinko
Stainless steel: ..... Not applied
Capacity (each): ..... 5,000m^3/h x 150mTH

Cargo control system
Make: ..... Nakakita
Type: ..... Hydraulic

Ballast control system
Make: ..... Nakakita
Type: ..... Hydraulic

Water ballast Treatment System
Make: ..... HiBallast (Hyundai)
Capacity: ..... 6,000m^3/h

Complement
Officers: 12
Crew: 18

Bridge control system
Make: ..... Kongsberg
One-man operation: ..... Yes

Fire detection system
Make: ..... Consilium-Iljin
Type: ..... addressable

Fire extinguishing systems
Cargo holds: ..... Deck foam
Make/Type: ..... NK
Engine room: ..... H.P. CO_2
Make/Type: ..... NK

Radars
Number: 2
Make: ..... JRC
Model(s): ..... JMR-9282-S for S-band / JMR-9225-6X for X-band

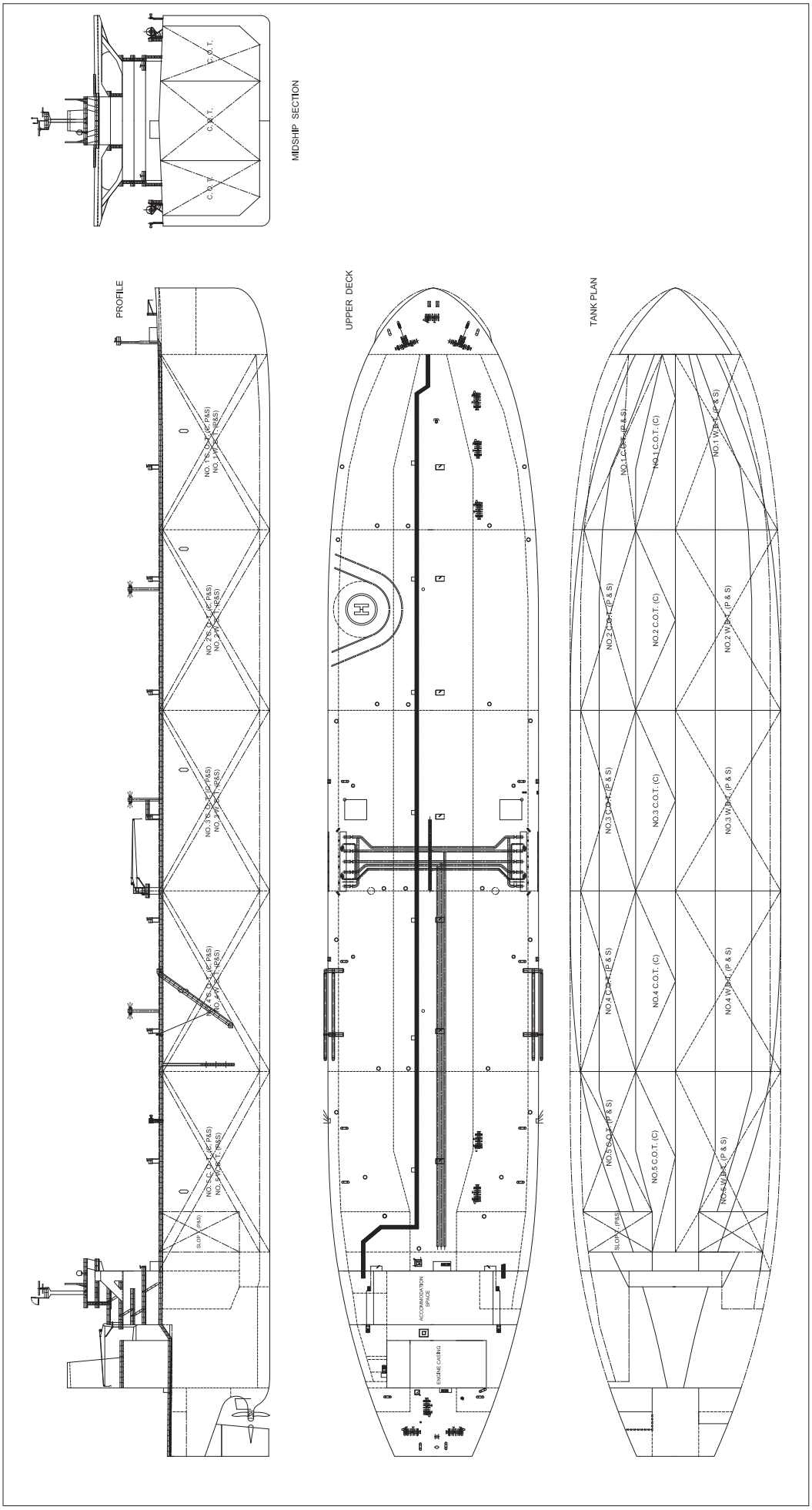
Integrated bridge system: ..... Yes
Make: ..... JRC
Model: JAN-9201

Contract date..... 20 January 2017

Launch/float-out date ..... 11 May 2018

Delivery date: ..... 27 July 2018

DHT BRONCO


MIDSHIP SECTION
C. O. T.
C. O. T.
C. O. T.
PROFILE
NO. 1C C.O.T. (P&S)
NO. 1 C.O.T. (C)
NO. 1 W.B.T. (P & S)
NO. 2C C.O.T. (P&S)
NO. 2 C.O.T. (C)
NO. 2 W.B.T. (P & S)
NO. 3C C.O.T. (P&S)
NO. 3 C.O.T. (C)
NO. 3 W.B.T. (P & S)
NO. 4C C.O.T. (P&S)
NO. 4 C.O.T. (C)
NO. 4 W.B.T. (P & S)
NO. 5C C.O.T. (P&S)
NO. 5 C.O.T. (C)
NO. 5 W.B.T. (P & S)
SLOP (P&S)
UPPER DECK
ACCOMMODATION SPACE
ENGINE CASING
TANK PLAN
NO. 1C C.O.T. (P & S)
NO. 1 C.O.T. (C)
NO. 1 W.B.T. (P & S)
NO. 2 C.O.T. (P & S)
NO. 2 C.O.T. (C)
NO. 2 W.B.T. (P & S)
NO. 3 C.O.T. (P & S)
NO. 3 C.O.T. (C)
NO. 3 W.B.T. (P & S)
NO. 4 C.O.T. (P & S)
NO. 4 C.O.T. (C)
NO. 4 W.B.T. (P & S)
NO. 5 C.O.T. (P & S)
NO. 5 C.O.T. (C)
NO. 5 W.B.T. (P & S)
SLOP (P&S)

EAGLE BARCELONA: Crude oil tanker

Shipbuilder: .....**Samsung Heavy Industries Co., Ltd.**
Vessel's name: ..... ***Eagle Barcelona***
Hull No: **SN2195**
Owner/Operator: ..... **AET Inc. Limited**
Country: .....**Singapore**
Designer: .....**Samsung Heavy Industries Co., Ltd.**
Country: .....**Republic of Korea**
Model test establishment used: ..... **Samsung Ship Model Basin**
Flag: .....**Singapore**
IMO number: **9795048**
Total number of sister ships already completed (excluding ship presented): **1**
Total number of sister ships still on order:..... **nil**

In 2015 AET, the tanker operating subsidiary of MISC in Malaysia, embarked on a fleet rejuvenation programme aimed at reducing the age of its tanker fleet and ensuring that it could meet the aims of its Green Sustainability Agenda.

Eagle Barcelona, delivered by Samsung Heavy Industries in January 2018, and its sister *Eagle Brisbane* which entered service three months later, are the first fruits of that decision. The two 113,327dwt Aframax crude carriers could potentially be the last newbuildings of the type with conventional HFO-fuel engines specified; the next two Aframax vessels ordered by AET from Samsung share the same hull design but are specified with dual-fuel engines.

The hull dimensions are typical for an Aframax being 250m in length and 43.8m beam. Draught of the 113,327dwt ship is 15.1m. *Eagle Barcelona* has six port side and six starboard side cargo tanks and two slop tanks. Cargo is discharged using three steam turbine pumps each with a 3,00m^3/h capacity. There is also a ballast water treatment system, but the make has not been disclosed.

Eagle Barcelona is fitted with a Doosan-built MAN B&W 6G60ME-C9 engine developing 11,200kW at 77rpm, giving a service speed of 14knots. The specification from AET ensured that, despite the oil-fuelled engines, the ships would incorporate state-of-the-art environmental innovations. The vessels are fully compliant with incoming regulations, including ballast water management, sulphur emission control and the requirement for carbon monitoring, reporting and verification. They will qualify for the Green Passport notation.

The energy saving innovations come from an optimised hull design and a number of Samsung's own design innovations. These include the SAVER fin – a hull fin fitted to the skeg forward of the propeller to direct water flow, a SAVER Stator which optimises the water flow to the propeller, STAR (Samsung Tip Advanced Rake) propeller and SARB (Samsung Asymmetric Rudder Bulb). Samsung says that taken together these devices improve fuel efficiency by around 6%.

TECHNICAL PARTICULARS

Length oa: 250m
Length bp: 243m
Breadth moulded: 43.8m
Depth moulded
To main deck: ..... 21.2 m
Draught
Scantling: 15.1m
Design: 13.6m
Gross: 61,000gt
Deadweight
Scantling: 113,000dwt
Speed, service: 14.5knots

Cargo capacity
Liquid volume: ..... 130,000m^3
Bunkers
Heavy oil: ..... 2,000m^3
Diesel oil: ..... 500m^3
Water ballast (m^3): ..... 39,000m^3
Tankers - percentage segregated ballast: 100%

Classification society and notations: ..... ABS + A1, Oil Carrier, ESP, +AMS, +ACCU, CPS, CSR AB-CM, RRDA, SPMA, UWILD, TCM, ENVIRO, CRC, BWT, RW, GP Service Restriction: Unrestricted Service

Main engines
Model: .....MAN 6G60ME-C9.5
Number: 1
Type of fuel:..... HFO or MDO
Propellers
Material: .....Ni-Al-Bronze
Number: 1
Fixed/controllable pitch: ..... Fixed
Diesel-driven alternators
Number: 3
Type of fuel: ..... HFO or MDO

Boilers
Number: 2
Type: .....Oil fired
Cargo cranes/cargo gear
Number: 1
Type: .....Electro-hydraulic single jib
Other cranes
Number: 2
Type: .....Electro-hydraulic single jib
Tasks: ..... Provision and equipment handling
Mooring equipment
Number: 10
Type: ..... Electro-hydraulic (High pressure)

Special lifesaving equipment
Number of each and capacity: 2
Type: ...Totally enclosed, gravity type lifeboat
Cargo tanks
Number: 12
Grades of cargo carried: .....Crude oil
Cargo pumps
Number: 3
Type: .....Centrifugal, steam turbine driven
Water Ballast Treatment System: .....Applied

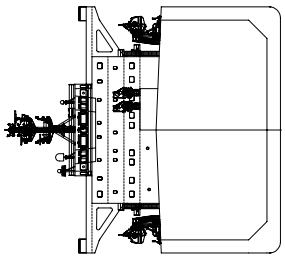
Complement
Officers: 14
Crew: 14
Supernumaries/Spare: ..... 2 (Pilot)
Suez/Repair Crew: 6

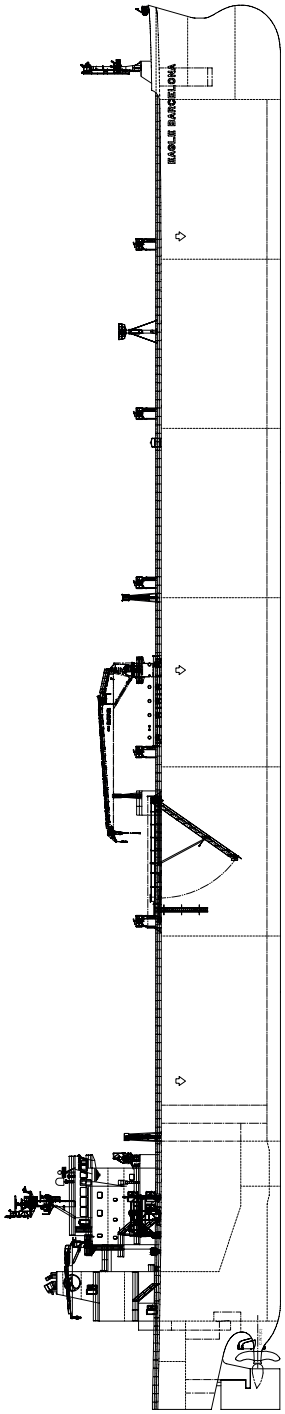
Bridge control system
Type: .....Applied
One-man operation: .....No

Fire detection system
Make: ..... Consilium
Type: ..... Salwico Fire Alarm System CCP
Fire extinguishing systems
Engine room:
Make/Type: ..... High expansion foam
Cabins:
Make/Type: ..... Fire hydrants
Public spaces:
Make/Type: ..... Fire hydrants
Radars
Number: .....3 sets

Contract date: ..... October 2015
Delivery date: ..... January 2018

EAGLE BARCELONA





FLAVIN: Crude/product carrier

Shipbuilder: ..... **Jiangsu New Hantong Ship Heavy Industry Co., Ltd**
Vessel's name: ..... ***Flavin***
Hull No: **HT-OT115-001**
Owner/Operator: ..... **Cardiff Marine**
Country: ..... **Greece**
Designer: ..... **Shanghai Merchant Ship Design and Research Institute (SDARI)**
Country: ..... **China**
Model test establishment used: ..... **HSVA**
Flag: ..... **Malta**
IMO number: **9787912**
Total number of sister ships already completed (excluding ship presented): **3**
Total number of sister ships still on order: **1**

Built by Jiangsu New Hantong Ship Heavy Industry to a SDARI design as the first of four 115,126dwt Aframax tankers, *Flavin* features a number of energy saving measures that its owner is now installing or retrofitting to most of its fleet. Ordered by Cardiff Marine, *Flavin* and its three sisters are operated by group subsidiary TMS Tankers.

As a crude/product carrier, *Flavin* was designed to operate in a highly competitive sector where efficiency can mean the difference between success and failure. The six cargo and one slop tanks located along each side of the vessel is a typical layout for the type. The twelve cargo tanks allow for three grades to be carried simultaneously. Cargo pumps are three Shinko types each with a capacity of 3,000m^3/h. The hull dimensions of 249.9m length and 44m beam are also typical for an Aframax type.

The significance of the ship is mainly hidden from view and centres on the operational performance. Its hull form was developed based on organic integration of SDARI's empirical method and numerical towing tank technology. The hull form has been optimised to achieve maximum energy efficiency over the range of speeds and draughts anticipated to operate in service. Further energy saving measures include a Mewis duct and the propeller is fitted with HVAF to recover the energy losses of the propeller hub vortex.

The main engine is a Doosan-built MAN B&W 6G50ME-C9.5-TII with an output of 12,400kW directly connected to the high-efficiency 8.15m fixed pitch propeller. Its service speed at design draught is 14.5knots at 85.5% SMCR.

Taken together, the engine and energy saving devices fitted have allowed *Flavin* to achieve an EEDI rating 24.15% below the base line. Since the ship is built well before the Phase II EEDI requirement of 20% reduction becomes effective in 2020, the achieved EEDI confirms the attractiveness of the ship to potential charterers.

TECHNICAL PARTICULARS

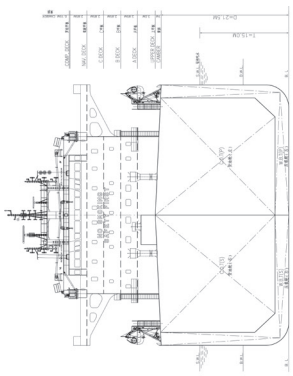
Length oa: 249.9m
Length bp: 241.6m
Breadth moulded: 44m
Depth moulded
To main deck: 21.5m
Width of double skin
Side: 2.2m
Bottom: 2.3m
Draught
Scantling: 15m
Design: 13.6m
Gross: 64,321gt
Displacement: 134,845t
Lightweight: 19,719t
Deadweight
Design: 100,773dwt
Scantling: 115,125dwt
Block co-efficient: 0.8313 (15m)
Speed, service: 14.5knots
Cargo capacity
Liquid volume: ..... 133,100m^3
Bunkers
Heavy oil: ..... 2,750m^3
Gas oil: ..... 730 m^3
Water ballast: ..... 39,000m^3
Daily fuel consumption
Main engine only: 45.66t/day
Auxiliaries: 4.7t/day
Classification society and notations: ..... ABS +A1, (E), Oil Carrier, CSR, AB-CM, CPS, ESP, SPMA, UWILD, +AMS, +ACCU, BWT, TCM, NIBS, VEC-L, ENVIRO, IHM, RRDA, POT,RW,BWE
% high-tensile steel used in construction: 65%

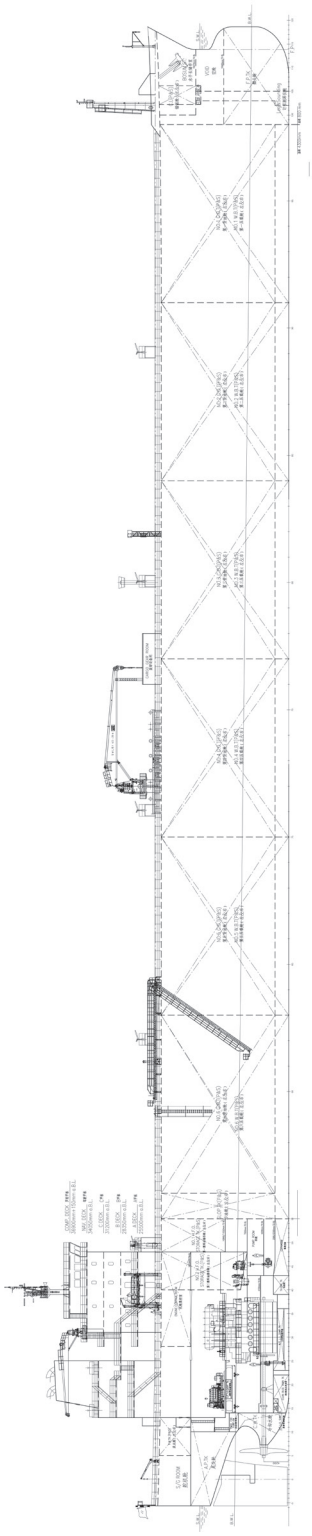
Main engines
Model: 6G50ME-C9.5-TII
Manufacturer: ..... Doosan Engine Co., Ltd.
Number: 1
Type of fuel: ..... HFO/MDO
Output of each engine: 12,400kW
Propellers
Material: ..... Ni-Al-Bronze
Number: 1
Fixed/controllable pitch: ..... Fixed
Diameter: 8.15m
Speed: 83.9rpm

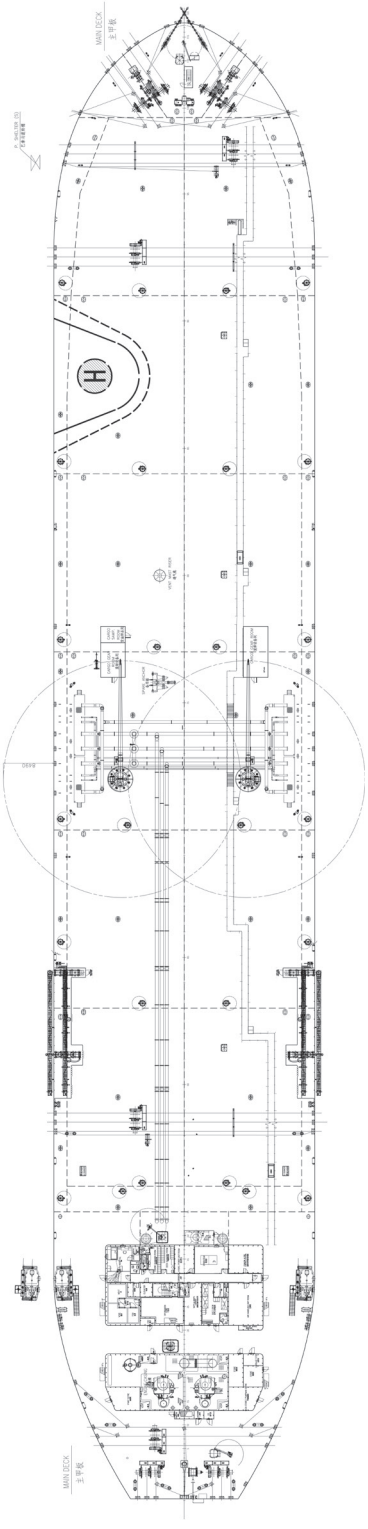
Diesel-driven alternators
Number: 3
Engine make/type: ..... Yanmar Co.,Ltd. / 6EY22ALW
Type of fuel: ..... HFO/MDO
Output/speed of each set: 1,100kW
Alternator make/type: ..... Taiyo Electric Co., Ltd.
Output/speed of each set: 1,020kW
Boilers
Number: 2
Type: ..... Vertical with burner and feed water regulator
Make: ..... Alfa Laval
Output, each boiler: 30,000kg/h
Cargo cranes/cargo gear
Number: 2
Make: ..... Jiangsu Masada Heavy Industrie Co.,Ltd
Type: ..... Electro-hydraulic, luffing slewing and single jib type
Performance: ..... 15t SWL @ max. outreach
Other cranes
Number: 1
Make: ..... Jiangsu Masada Heavy Industrie Co.,Ltd
Type: ... Electro-hydraulic, luffing slewing and single jib type
Tasks: ..... Provision handling
Performance: ..... 4t SWL @ max. outreach
Number: 1
Make: ..... Jiangsu Masada Heavy Industrie Co.,Ltd
Type: ... Electro-hydraulic, luffing slewing and single jib type
Tasks: ..... Provision handling
Performance: ..... 2t SWL @ max. outreach

Mooring equipment
Number: 6
Make: ..... Jiangsu Masada Heavy Industrie Co.,Ltd
Type: ..... Hydraulic
Special lifesaving equipment:
Number and capacity: ..... 2x 32 persons
Make: ..... Jiangyinshi Beihai LSA Co.,Ltd
Type: ..... Free-fall lifeboat
Cargo tanks
Number: 12
Grades of cargo carried: 3
Product range: ..... Crude oil
Cargo pumps
Number: 3
Type: ... Steam turbine driven centrifugal pump
Make: ..... Shinko Ind.Ltd
Capacity (each): ..... 3,000m^3/h
Cargo control system
Type: ..... Hydraulic remote control
Ballast control system
Type: ..... Hydraulic remote control
Water Ballast Treatment System
Make: ..... SunRui Marine Environment Engineering Co.Ltd
Capacity: ..... 2 x 2,000m^3/h
Complement
Officers: 14
Crew: 14
Supernumaries/Spare: 2
Suez/Repair Crew: 6
Single/double/other rooms: 30/0/1
Bridge control system
Make: ..... Furuno

Fire detection system
Make: ..... Consilium
Type: ..... Salwico Cargo
Fire extinguishing systems
Cargo holds: ..... Deck foam
Make/Type: ..... Tyco
Engine room: ..... High expansion foam
Make/Type: ..... Tyco
Radars
Number: 2
Make: ..... Furuno
Model(s): ..... FAR-3320&FAR-3330S-SSD
Integrated bridge system
Make: ..... Furuno
Contract date: ..... November 2015
Launch/float-out date: ..... September 2017
Delivery date: ..... March 2018







IBERIAN SEA: Tanker

Shipbuilder: ..... **HHIC-Phil INC.**
Vessel's name: ..... ***Iberian Sea***
Hull No: **NTP0157**
Owner/Operator: ..... **Eastern Pacific Shipping Pte. Ltd**
Country: ..... **Singapore**
Designer: ..... **HHIC-Phil Korea / HHIC-Tech Inc**
Country: ..... **Republic of Korea / Republic of the Philippines**
Model test establishment used: ..... **KRISO**
Flag: ..... **Liberia**
IMO number: **9815604**
Total number of sister ships already completed (excluding ship presented): ..... **nil**
Total number of sister ships still on order: **3**

Iberian Sea is the first of a four-ship series of Aframax tankers built by Hanjin Heavy Industries & Construction – Philippines (HHIC-Phil) for Singapore-based Eastern Pacific Shipping.

The first two vessels were ordered in 2016 and the second pair some months later. Both pairs were constructed in parallel with the keels of the first pair laid down on 18 December 2017. The second ship in the series – *Levantine Sea* – was delivered just four days after its older sister. The third and fourth vessels – *Caspian Sea* and *Tyrrhenian Sea* – were delivered on 14 and 23 January 2019 respectively. Since taking the orders from eastern Pacific, HHIC-Phil has secured several more orders from other owners for essentially identical vessels.

Each of the tankers measures 249.8m in length and 44m in width. Deadweight is 114,218t – a size which has become very popular for Aframax tankers and which is towards the upper limit of the type. The hull dimensions allow passage through the new Panama locks adding to the flexibility of the ship. Cargo arrangements for the crude/product tankers comprise six port and six starboard epoxy coated cargo tanks and two slop tanks. There is three grade segregation and three Shinko steam cargo pumps, each with a capacity of 3,000m^3/h.

The propulsion system features an STX-built MAN B&W 6G60ME-C9.5 main engine rated at 13,500kW @87rpm directly linked to an 8m propeller. The ship is also fitted with a Mewis duct and a semi-spade rudder with bulb. The arrangement gives a service speed of 14knots. Auxiliary engines are three MAN 6L23/30H models each rated at 960kW. On delivery of the first two vessels, the builder's announcement said the ships were equipped with exhaust gas scrubbing systems although the maker was not named.

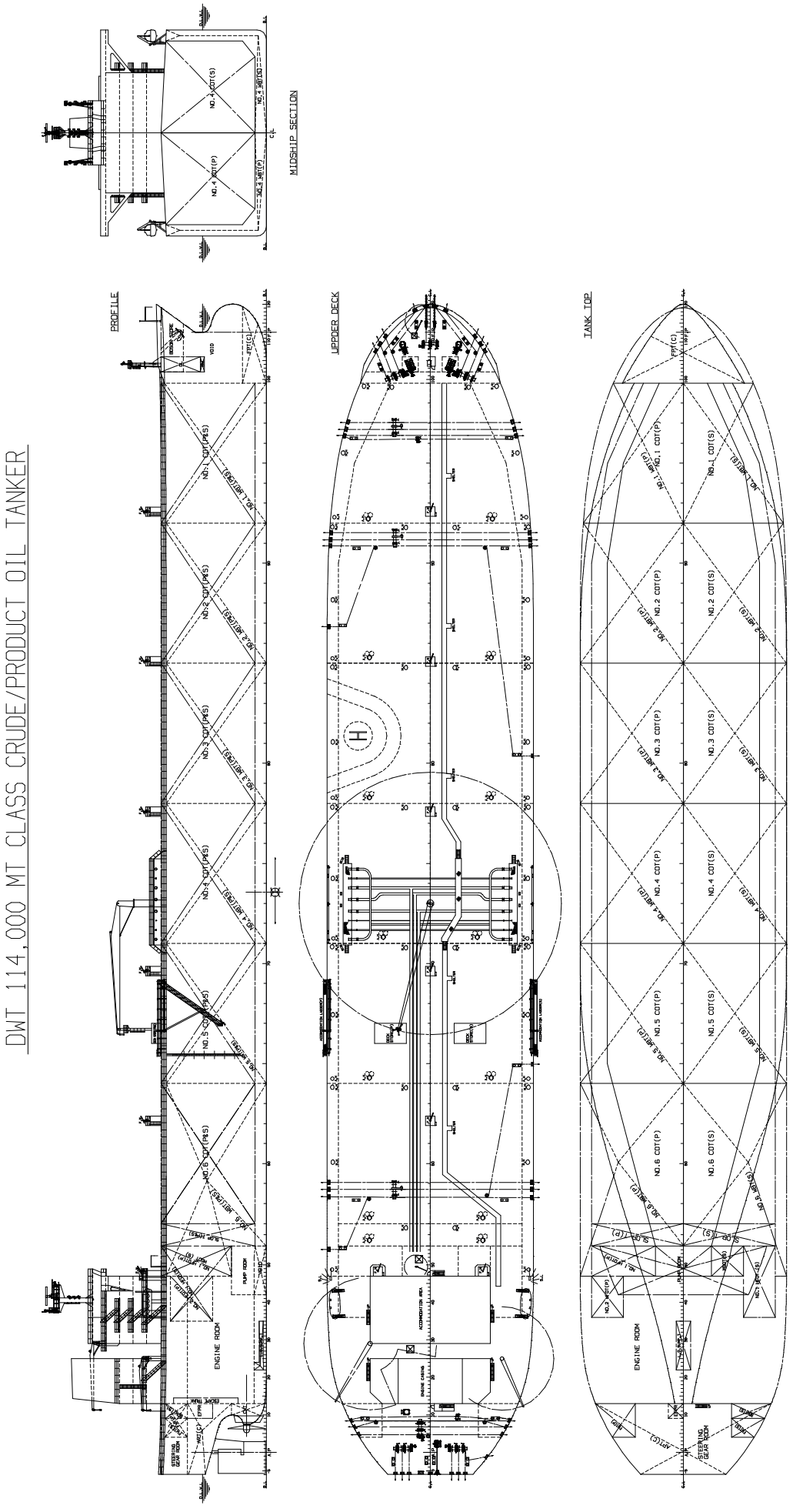
As a newbuilding the ship is obliged to meet IMO ballast water convention requirements and to this end the ship has been fitted with a 3,000m^3/h Evoqua SeaCURE system.

TECHNICAL PARTICULARS

Length oa: 249.8m
Length bp: 239.0m
Breadth moulded: 44.0m
Depth moulded
  To main deck: 21.35m
  To upper deck: 21.35m
Width of double skin
  Side: 2.4m
  Bottom: 2.4m
Draught
  Scantling: ..... 15.1m (mld.)
  Design: ..... 13.6m (mld.)
Gross: 63,416gt
Deadweight
  Design: 99,100dwt
  Scantling: 114,218dwt
Speed, service (74.9% MCR output): 14.5knots

Cargo capacity
  Liquid volume: ..... 130,200m^3
Bunkers
  Heavy oil: ..... 2,880m^3
  Diesel oil: ..... 650m^3
Water ballast: ..... 39,800m^3
Daily fuel consumption
  Main engine only: 39.0t/day
  Auxiliaries: ..... 7.5 t/day (G/E x 2sets), 2.7t/day (G/E x 1set)
Classification society and notations: ..... ABS +A1, E,Oil Carrier,+AMS,+ACCU,CSR AB-CM,CPS, SPMA,ESP,BWE.BWT, ENVIRO, TCM, VEC-L, IHM, RW, RRDA, CRC, UWILD, ICE CLASS IC
Roll-stabilisation equipment: ..... Bilge keel
Main engines
  Design: ..... MAN Diesel Turbo
  Model: 6G 60ME-C9.5
  Manufacturer: .. STX Heavy Industries Co., Ltd.
  Number: 1
  Type of fuel: ..... HFO or MDO
  Output of each engine: .. 13,500kW at 87rpm
Propellers
  Material: ..... Ni-Al-Bronze
  Designer/Manufacturer: .... HHIC-Phil Korea / HHI
  Number: 1
  Fixed/Controllable pitch: ..... Fixed
  Diameter: 8,000mm
  Speed: 87.0rpm/min
Diesel-driven alternators
  Number: 3
  Engine make/type: ....STX engine / STX-MAN 6L 23/30H
  Type of fuel: ..... HFO or MDO
  Output/speed of each set: 960kW at 900rpm
  Alternator make/type: ..... HHI-EES
Output/speed of each set: 900kW/900rpm
Boilers
  Number: 3
  Type: .....Large oil-fired boiler aux. boiler, Vertical composite smoke/smoke tube boiler
  Make: ..... Alfa Laval
  Output, each boiler: ..... Aux. boiler 25,000kg/h x 16kg/cm^2(2sets), Composite boiler 1,500/800kg/h x 6kg/cm^2
Cargo cranes/cargo gear
  Number: 1
  Make: ..... DMC
  Type: ..... Electro-hydraulic driven
  Performance: ..... 15t SWL
Mooring equipment
  Number: 9
  Make: ..... Flutek
  Type: ..... Electro-hydraulic driven
Special lifesaving equipment
  Number of each and capacity: .....2 x 28 persons
  Make: ..... DSB Eng.
  Type: ..... Hinged gravity
Cargo tanks
  Number: ....14 (12 cargo tanks, 2 slop tanks)
  Grades of cargo carried: ..... SEG.I, II, III
  Product range: ..... Crude oil, petroleum Products in the list of oil (MARPOL 73/78 Annex I), Carbon black feed stock, production water
  Coated tanks: ..... CMP and Epoxy paint
Cargo pumps
  Number: 3
  Type: ..... Steam turbine driven, vertical, centrifugal
  Make: ..... Shinko
  Stainless steel: ..... Impeller shaft & key, Seal rings, Springs
  Capacity (each): ..... 3,000m^3/h x 130 mTh
Cargo control system
  Make: ..... KSB Seil
  Type: ..... Electro hydraulic
Ballast control system
  Make: ..... KSB Seil
  Type: ..... Electro hydraulic
Water Ballast Treatment System
  Make: ..... Evoqua
  Capacity: ..... 3,000m^3/h
Complement
  Officers: 15
  Crew: 13
Stern appendages/special rudders: ..... Mewis duct/Semi-spade rodder with rudder bulb
Bridge control system
  Make: ..... Hyundai Electric
  Type: .....Integrated bridge console
  One-man operation: .....No
Fire detection system
  Make: ..... Autronica
  Type: .....AutroSafe
Fire extinguishing systems
  Engine room: ..... Foam
  Make/Type: ..... NK / High expansion foam
  Deck: ..... Foam
  Make/Type: ..... NK / Low expansion foam
Radars
  Number: 2
  Make: ..... Furuno
  Model(s): .. FAR-3220W-BB / FAR-3230W-BB
Integrated bridge system: .....Yes
  Make: ..... Furuno
  Model: FMD-3200-BB
Waste disposal plant
  Waste handled: ..... Partially handled
  Incinerator
    Make: ..... HMMCO
    Model:.....MAXI NG 100SL WS
  Sewage plant
    Make: ..... Il Seung
    Model: ISB-02V

Contract date: ..... 6 September 2016
Launch/float-out date: .....21 April 2018
Delivery date: ..... 17 November 2018


DWT 114,000 MT CLASS CRUDE/PRODUCT OIL TANKER
MIDSHIP SECTION
PROFILE
UPPER DECK
TANK TOP
ENGINE ROOM
PUMP ROOM
STEERING GEAR ROOM
ACCOMODATION AREA

MORVIKEN: Crude oil tanker

Shipbuilder: .....**Samsung Heavy Industries Co., Ltd.**
Vessel's name: ..... ***Morviken***
Hull No: **SN2199**
Owner/Operator: ..... **Viken Crude AS**
Country: ..... **Norway**
Designer: .....**Samsung Heavy Industries Co., Ltd.**
Country: .....**Republic of Korea**
Model test establishment used: ... **Samsung Ship Model Basin**
Flag: ..... **NIS**
IMO number: **9817494**
Total number of sister ships already completed (excluding ship presented): **1**

For crude oil tanker operators, 2018 was not the best of years from a commercial standpoint with freight rates mostly depressed. However, owners and operators have to take a longer view and for Bergen-based Viken Crude there was an even more pressing need. The company was only founded in 2015 and is gradually building a fleet presence.

The first new ships ordered by the joint venture (established by Steckmest's Viken Shipping and Frederik Mohn's Perestroika) were the 157,610dwt Suezmax crude carrier *Morviken* and its sister along with a pair of Aframaxes. The ships were ordered in 2016 with the contract bringing some relief to the then hard-pressed builder Samsung Heavy Industries. All four of Viken's newbuildings were fixed on long-term time charters to French oil major Total at the time of ordering in 2016.

There is a typical Suezmax tank layout comprising six pairs of port and starboard tanks along with a pair of slop tanks. The three cargo pumps are centrifugal steam turbine driven types, each able to pump at the rate of 3,800m^3/h.

Morviken is 275m long making it at the very limit of the type's permitted dimensions but the beam of 49m is well inside the maximum allowing the ship to have a draught of 17.22m. The optimised hull form has been enhanced with Samsung's own in-house developed energy saving devices including the SAVER fin on the hull, a SAVER Stator to better direct the water flow to the propeller and STAR (Samsung Tip Advanced Rake) propeller and SARB (Samsung Asymmetric Rudder Bulb). The combination is expected to give the vessel a fuel efficiency saving of around 6%.

The new vessel is fitted with an electronically controlled MAN B&W 6G70ME-C two-stroke engine built by Hyundai Heavy Industries. Its power output is 16,400kW at 77rpm. The service speed is 15knots on a fuel consumption of around 60tonnes per day.

TECHNICAL PARTICULARS

Length oa: 274.3m
Length bp: 267.0m
Breadth moulded: 49m
Depth moulded
To upper deck: 23.3m
Draught
Scantling: 17.2m

Gross: 81,000gt
Deadweight
Scantling: 157,610dwt

Speed, service: 14.5knots

Cargo capacity
Liquid volume: ..... 170,000m^3

Bunkers
Heavy oil: ..... 3,000m^3
Diesel oil: ..... 300m^3

Water ballast: ..... 49,000m^3
Tankers - percentage segregated ballast: 100%

Classification society and notations: ..... Bureau Veritas
I Hull Mach Oil tanker CSR CPS(WBT) ESP CPS(COT), VeriSTAR-HULL CM, AUT-UMS (SS), AUT-PORT (SS), SYS-NEQ-1 (SS), MON-SHAFT, GREEN PASSPORT, BWT, CLEANSHIP, ERS-S, SEEMP, INWATERSURVEY, SPM, VCS, CARGO-CONTROL, MANOVR, LI-HG-S3 Unrestricted navigation

Main engines
Model: .....MAN 6G70ME-C9.5
Manufacturer: ..... MAN Energy Solutions
Number: 1
Type of fuel: ..... HFO or MDO

Propellers
Material: .....Ni-Al-Bronze
Number: 1
Fixed/controllable pitch: ..... Fixed
Diesel-driven alternators
Number: 3
Type of fuel:..... HFO or MDO
Boilers
Number: 2
Type: .....Oil fired
Cargo cranes/cargo gear
Number: 2
Type: .....Electro-hydraulic single jib
Other cranes
Number: 2
Type: .....Electro-hydraulic single jib
Tasks: .....Provision and equipment handling crane
Mooring equipment
Number: 9
Type: ..electro-hydraulic type (High pressure)

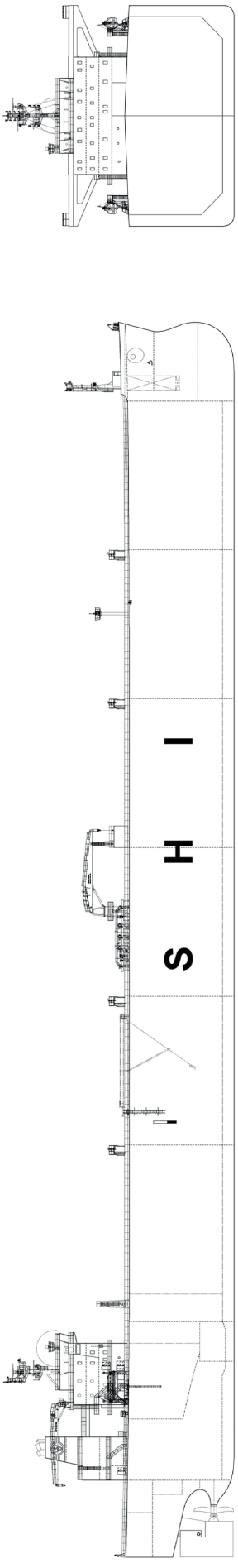
Special lifesaving equipment
Number of each and capacity: 2
Type: ... Totally enclosed, gravity type lifeboat

Cargo tanks
Number: 12
Grades of cargo carried: .....Crude oil
Cargo pumps
Number: 3
Type: .....Centrifugal, steam turbine driven
Water Ballast Treatment System: .....Applied

Complement
Officers: 14
Crew: 12
Suez/Repair Crew: 6

Bridge control system
Type: .....Applied
One-man operation: .....Yes

Fire detection system
Make: ..... Consilium
Type: ..... Salwico Fire Alarm System CCP
Fire extinguishing systems
Engine room
Type: .....High expansion form
Cabins
Type: ..... Fire hydrants
Public spaces
Type: ..... Fire hydrants
Radars
Number: 3
Integrated bridge system: .....Yes
Waste disposal plant
Incinerator
Model:..... Applied
Sewage plant
Type: ..... Biological
Contract date: ..... October 2016
Delivery date: .....April 2018


S H I

DIJILAH: Crude oil tanker

Shipbuilder: ..... **Samsung Heavy Industries**
Vessel's name: ..... ***Dijilah***
Owner/Operator: ... **Al-Iraqia Shipping Services & Oil Trading (AISSOT)**
Country: ..... **UAE**
Designer: ..... **Samsung Heavy Industries**
Country: ..... **Republic of Korea**
Flag: ..... **Marshall Islands**
IMO number: **9829629**
Total number of sister ships already completed (excluding ship presented): **4**
Total number of sister ships still on order: ..... **Nil**

Originally ordered by Singapore-based BW Group, the 320,596dwt VLCC *Dijilah* debuted in January as the first newbuilding owned and operated by the 2017-formed Iraqi company Al-Iraqia Shipping Services & Oil Trading (AISSOT).

Dijilah is the first in a series of four identical sisters built by South Korean builder Samsung Heavy Industries. The other three ships – *Ninawa, Diyala* and *Kirkuk* – were delivered shortly afterwards in March, April and May respectively. BW's order for the vessels was made in May 2017, one month after the new owner to which they would be sold while still under construction was founded. The order was also notable for Samsung as it marked the first VLCCs the yard had secured in nearly a decade.

Cargo arrangements are typical for a VLCC, with five sets of port, centre and starboard tanks, making 15 in all. Three SHINCO steam cargo pumps of 5,300m^3/h capacity allow for three grade segregation of the cargo.

The ship has a vertical bow form with no bulb. Hull dimensions are a length of 330m, a beam of 60m and a moulded depth of 30.5m.

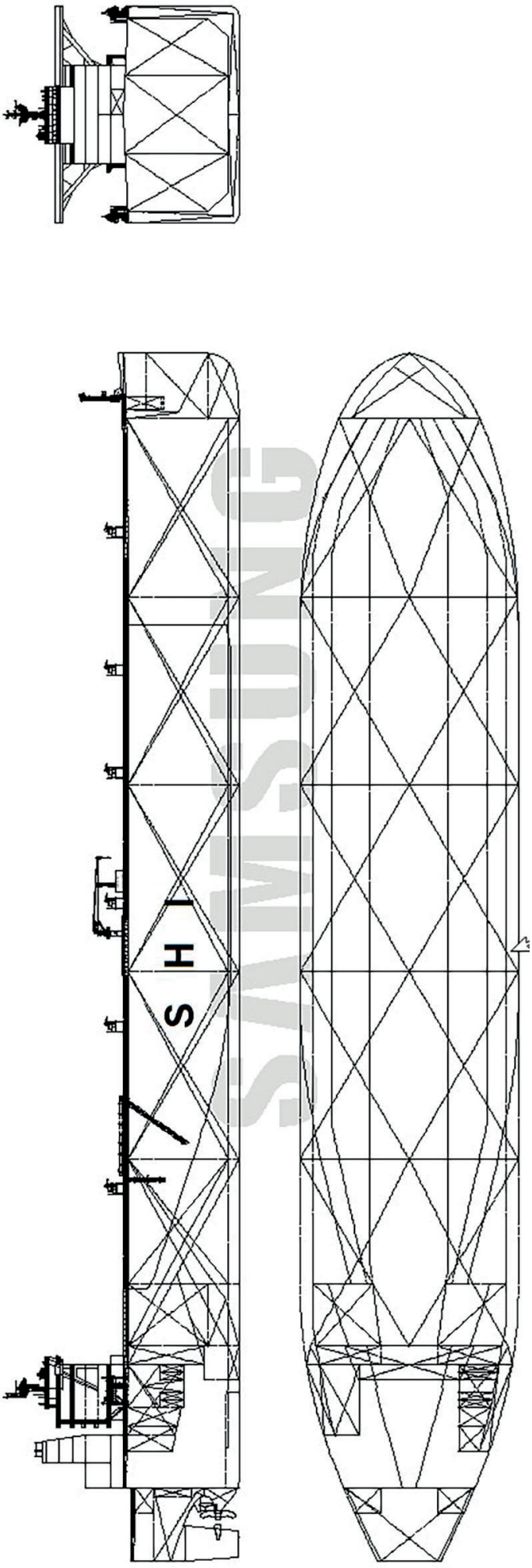
The power and propulsion system features a Doosan-built MAN B&W 7G80ME-C9 main engine with an output of 26,890kW. It is directly connected to a 10.4m diameter fixed pitch propeller turning at 72rpm. The arrangement gives the ship a service speed of 14.5knots on a fuel consumption of 70.5tonnes per day.

Dijilah is fitted with a variety of Samsung's in-house energy saving devices and systems. Included in these are a rudder bulb, SAVER Fins and a SAVER Stator. The SAVER Fins, which are attached to the hull, produces a series of strong vertical streams making inflow of the propeller more uniformly distributed. Meanwhile, the SAVER Stator improves the propeller's rotational energy efficiency. The ship also features Samsung's En-Saver performance monitoring and trim optimisation software.

TECHNICAL PARTICULARS

Length oa: ..... Approx. 333m
Length bp: 326.4m
Breadth moulded: 60.0m
Depth moulded
to upper deck: 30.5m
Width of double skin
side: 3.4m
bottom: 3.0m
Draught
scantling: 22.8m
design: 21.0m
Gross: 161,960gt
Displacement: 364,700t
Lightweight: 44,200t
Deadweight
scantling: 320,500t
design: 288,400t
Block co-efficient: .....0.788 at design draught
Speed, service: ..... 14.8knots incl. 15% power margin (65.9% DMCR)
Cargo capacity (m^3)
Liquid volume: 354,000
Bunkers (m^3)
Heavy oil: 6,700
Diesel oil: 1,100
Water ballast (m^3): 96,000
Tankers – percentage segregated ballast: ...100%
Daily fuel consumption (tonnes/day)
Main engine only: 64.6
Classification society and notations: ..... Lloyd's Register of Shipping ✠100A1, Double Hull Oil Tanker, CSR, ESP, ShipRight(ACS(B,C), CM), LI, ✠LMC, UMS, ECO(BWT, IHM, P, VECS-L) , COW(LR), *IWS(no seachest blanking device), with Descriptive Notes : ShipRight(BWMP(T), SCM, SERS)
% high-tensile steel used in construction: 75%
Propulsion
Design: ..... MAN Energy Solutions
Model: ..... MAN B&W 7G80ME-C9.5
Manufacturer: .....HSD Engine
Number: 1
Type of fuel: .....HFO or MGO
Output of each engine: 26,890kW
Is this a diesel-electric or hybrid?: .....No
Propeller(s)
Material: .....Ni-Al-Bronze
Designer/Manufacturer: ..... Samsung Heavy Industries/Silla Metal
Number: 1
Fixed/Controllable pitch: .....Fixed
Diameter: 10.4m
Speed: ..... 72rpm at DMCR
Diesel-driven alternators
Number: 3
Engine make/type: .....Hyundai Heavy Industries/7H21/32
Type of fuel: .....HFO or MGO
Alternator make/type: .....Hyundai / HFJ7 568-08P
Output/speed of each set: .....1,812.5kVA / 900rpm
Boilers
Number: 3
Type: .....Oil fired x 2sets, composite x 1set
Make: .....Kangrim
Output, each boiler: ..... 40,000kg/h x 2sets, 1,800(oil fired side)/1,500(exh. gas side) kg/h x 1set
Stern appendages/special rudders: ...Full spade rudder
Deck machinery
Cargo cranes/cargo gear
Number: 2
Make: .....Oriental Precision
Type: .....High pressure, electro-hydraulic self-contained, single jib type
Performance: .....20.0tons SWL, each
Other cranes
Number: 2
Make: .....Oriental Precision
Type: .....High pressure, electro-hydraulic self-contained, single jib type
Tasks: .....For provision / engine room equipment handling
Performance: .....1x 10.0t SWL, 1x 3.0t SWL
Mooring equipment
Number: 2x - 1 C/L + 2 M/D + 1 W/H, each, 8x – 2 M/D + 1 W/H, each
Make: .....Flutek
Type: High pressure, electro-hydraulic driven
Special lifesaving equipment
Number of each and capacity: ....2x 30 persons
Make: .....Hyundai Lifeboat (HLB)
Type: ..... Totally enclosed conventional
Cargo tanks
Number: 15
Grades of cargo carried: .....3x segregations
Product range: .....Crude oil
Coated tanks – make and type: ... PPG, Epoxy A/C according to PSPC
Cargo pumps
Number: 3
Type: ..... Centrifugal, steam turbine driven
Make: ..... SHINCO
Capacity (each): ..... 5,500m^3/h x 150m at S.G 1.025
Cargo control system
Make: ..... KSB Seil
Type: ..... Hydraulic type valve remote control
Ballast control system
Make: ..... KSB Seil
Type: ..... Hydraulic type valve remote control
Ballast water treatment system
Make: ..... Samsung Heavy Industries
Capacity: ..... 6,000m^3/h
Complement
Officers:.....14 persons
Crew: .....16 persons
Suez/Repair Crew: .....6 persons
Single/double/other rooms: .....30 cabins (single), 1 cabin (3 double)
Navigation and other equipment
Bridge control system
Make/Type: Nabtesco/M-800-V
Is bridge fitted for one-man operation? .....No
Integrated bridge system?: ..... Yes
If yes, make: .....Furuno
Model: .....FMD-3300 and etc
Radars
Number: 2
Make: .....Furuno
Model(s): .... 1 x FAR-2837S + 1 x FAR-2827
Fire detection system
Make/Type: ..... Consilium/Salwico
Fire extinguishing systems
Engine room: ..... NK / High expansion form
Cabins: ..... Fire hydrants
Public spaces: ..... Fire hydrants
Waste disposal plant
Incinerator
Make/Model: .... HMMCO/MAXI 150SL WS
Sewage plant
Make/Model: .....IL Seung/ISB-03
Efficiency
Attained EEDI value: 2.14
Required EEDI value: .....2.256 (Phase 1)
Installed Fuel Meters: Volumetric type for fuel oil
Energy Saving Technologies*: ..... SAVER Fins, Rudder bulb, SAVER Sator with Partial Duct, En-Saver
Performance Monitoring Regime:.... En-Saver of Optimum weather routing / Trim optimisation

Contract date: ..... 28 April 2017
Launch/float-out date: .....1 November 2018
Delivery date: .....17 January 2019


SHI
SAMSUNG

EAGLE BRASILIA: Crude oil tanker

Shipbuilder: ..... **Samsung Heavy Industries**
Vessel's name: ..... ***Eagle Brasilia***
Owner/Operator: ..... **AET Tankers Pte Ltd**
Country: ..... **Malaysia**
Designer: ..... **Samsung Heavy Industries**
Country: ..... **Republic of Korea**
Flag: ..... **Malaysia**
IMO number: **9795062**
Total number of sister ships already completed (excluding ship presented): **1**
Total number of sister ships still on order: ..... **Nil**

A pair of cylindrical tanks just forward of the superstructure mark *Eagle Brasilia* as something beyond the run of the mill Aframax tankers. The tanks are there because the 118,110dwt vessel is in fact one of the tankers to be fitted with a dual-fuel engine intended to run on LNG.

Eagle Brasilia is the first of a pair of dual-fuel tankers built by Samsung for MISC subsidiary AET Tankers as part of its fleet renewal programme, which began in 2017. The ship was handed over in January one month before its sister *Eagle Bintulu*.

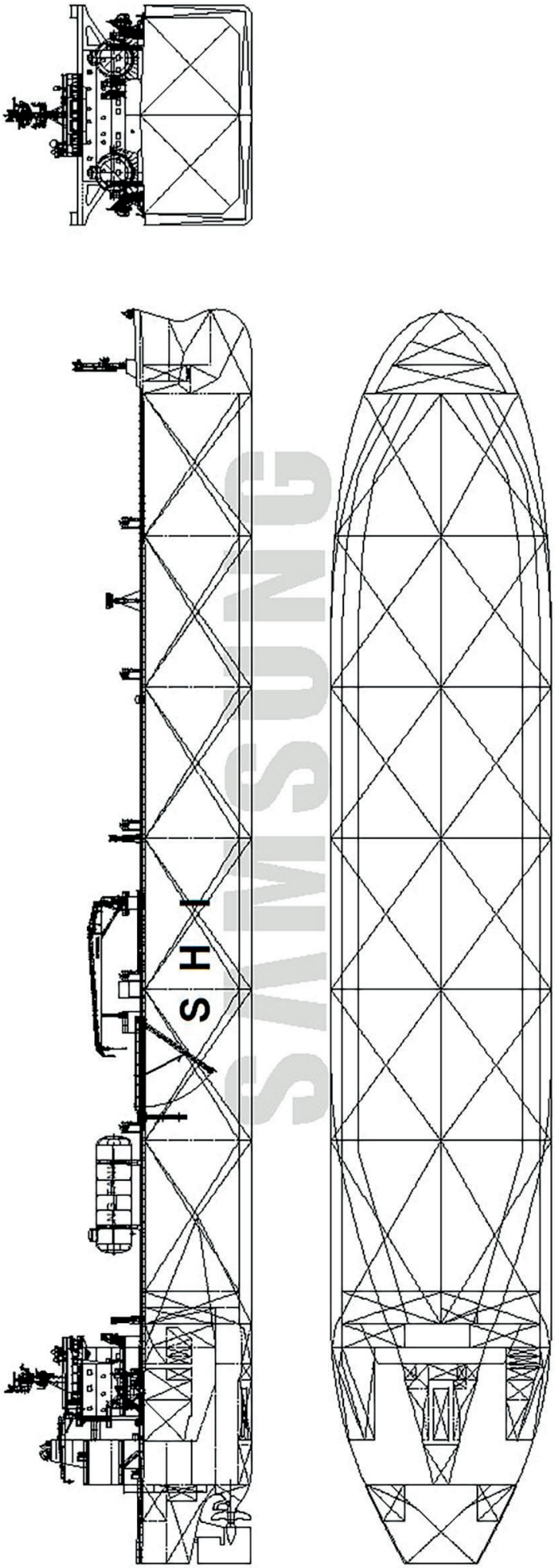
Sovcomflot beat AET in the race to become the first company with a dual-fuelled Aframax; but that doesn't detract from AET's leading role in the uptake of LNG fuelled tankers. Beyond being AET's first dual-fuel ship, *Eagle Brasilia* is also the first of any kind to feature Samsung's proprietary S-FuGaS LNG fuel system. S-FuGaS is composed of 850m^3 C-type tanks for storing extremely low temperature LNG as well as a system supplying LNG at the temperature and pressure required by the engines by vaporisation. The two tanks confer a range of 6,000nm. The supplying pressure of natural gas delivery depends on the specifications of the main engines. Each tank has two LNG feed pumps for full redundancy.

TECHNICAL PARTICULARS

Length oa: ..... Approx. 250m
Length bp: 243.0m
Breadth moulded: 43.8m
Depth moulded
to upper deck: 21.2m
Width of double skin
side: 2.35m
bottom: 2.4m
Draught
scantling: 15.1m
design: 13.6m
Gross: 62,150gt
Displacement: 112,900t
Lightweight: 20,000t
Deadweight
scantling: 132,900t
design: 118,100t
Block co-efficient: .....0.796 at design draught
Speed, service: .....14.5knots incl. 15% Power Margin (82.3% DMCR)
Cargo capacity (m^3)
Liquid volume: 129,000
Bunkers (m^3)
Heavy oil: 2,400
Diesel oil: 500
Water ballast (m^3): 40,000
Tankers – percentage segregated ballast: ...100%
Daily fuel consumption (tonnes/day)
Main engine only: 38.2
Classification society and notations: ..... ABS ✠A1 E , Oil carrier, CSR, ESP, CPS, AB-CM, TCM, ✠AMS, ✠ACCU, SPMA, GP, BWT, ENVIRO, UWILD(no seachest blanking device), GFS
% high-tensile steel used in construction: 75%
Propulsion
Design: .....WinGD
Model: 6X62DF
Manufacturer: .....HSD engine
Number: 1
Type of fuel: .....HFO, MDO or LNG
Output of each engine: ....11,200kW (DMCR)
Is this a diesel-electric or hybrid?: .....No
Propeller(s)
Material: .....Ni-Al-Bronze
Designer/Manufacturer : .....Samsung Heavy Industries/Hyundai Heavy Industries
Number: 1
Fixed/Controllable pitch: .....Fixed
Diameter: 8.0m
Speed: ..... 80.7rpm at DMCR
Diesel-driven alternators
Number: .....3 sets
Engine make/type: .....Hyundai Heavy .....Industries/ 6L20DF
Type of fuel : .....HFO, MDO or LNG
Alternator make/type: Hyundai / HFJ7 508-6P
Output/speed of each set: .....1,312.5kVA / 1,200rpm
Boilers
Number: ..... 2 x DF aux. boilers, 1 x composite boiler
Type
Aux. boilers: .. Dual fuel (HFO, MDO, LNG)
Composite boiler: Oil fired (HFO or MDO)
Make: .....Alfa Laval
Output, each boiler: .....DF aux. boiler: 25t/h
Composite boiler: .....1.2t/h (oil fired section) / 1.1t/h (exh. gas section)
Deck machinery
Cargo cranes/cargo gear
Number: 1
Make: .....SSII
Type: .....High pressure, electro-hydraulic
Performance: .....15.0t SWL
Other cranes
Number: 2
Make: .....SSII
Type: .....High pressure, electro-hydraulic
Tasks: .....For provision / engine room equipment handling
Performance: ..... 1 x 5.0t SWL, 1 x 1.0t SWL
Mooring equipment
Number: ... 2 x 1 C/L + 2 M/D + 1 W/H, each; 6 x 2 M/D + 1 W/H, each, 2 x 1 M/D
Make: .....Flutek
Type: ....High pressure, electro-hydraulic driven
Special lifesaving equipment
Number of each and capacity: ...2 x 35 persons
Make: .....Hyundai Lifeboat (HLB)
Type: ..... Totally enclosed conventional type
Cargo tanks
Number: 12
Grades of cargo carried: .....3 segregations
Product range: .....Crude oil
Coated tanks – make and type: ... Jotun, Epoxy A/C according to PSPC
Cargo pumps
Number: 3
Type: ..... Centrifugal, steam turbine driven
Make: ..... SHINCO
Capacity (each): ..... 3,000m^3/h x 130m at S.G 1.025
Cargo control system
Make: .....KSB Seil
Type: .....Hydraulic remote control system
Ballast control system
Make: .....KSB Seil
Type: .....Hydraulic type valve remote control
Ballast water treatment system
Make: .....Samsung - S&SYS
Capacity: ..... 4,000m^3/h
Complement
Officers:..... 16 persons
Crew: .....14 persons
Suez/Repair Crew: .....6 persons
Single/double/other rooms: .....30 cabins (single), 1 cabin (3 double)
Navigation and other equipment
Bridge control system
Make/Type: .....Kongsberg/AutoChief 600
Is bridge fitted for one-man operation? .....No
Integrated bridge system?: ..... Yes
If yes, make: ..... JRC
Model: .....JAN-9201 and etc
Radars
Number: 3
Make: ..... JRC
Model(s): ..... 1 x JMR-9282-S + 2 x JMR-9225-6X
Fire detection system
Make/Type: ..... Consilium/Salwico
Fire extinguishing systems
Engine room:
Make/Type: ..... NK / High expansion form
Cabins:: ..... - / Fire hydrants
Public spaces: ..... - / Fire hydrants
Waste disposal plant
Incinerator
Make/Model: HMMCO/ MAXI T150SL WS
Sewage plant
Make/Model: ..... Il Seung/ISB-03
Efficiency
Attained EEDI value: 2.941
Required EEDI value: .....3.752 (Phase 1)
Installed Fuel Meters: .....Ship performance monitoring system with shaft torque meter
Energy Saving Technologies*: ..... SAVER-Fins, Rudder bulb, SAVER SATOR, EN-SAVER (Smart ship solution), VFD (Main CSW pumps, LNG Fuel pumps, M/E El. Balancer)

Contract date: .....27 October 2015
Launch/float-out date: .....12 June 2018
Delivery date: .....4 January 2019

EAGLE BRASILIA



HUNTER ATLA: Very large crude carrier

Shipbuilder: ....**Daewoo Shipbuilding & Marine Engineering Co., Ltd. (DSME)**
Vessel's name: ..... ***Hunter Atla***
Hull No: **5455**
Owner/Operator: ..... **Hunter Tanker AS**
Country: ..... **Norway**
Designer: ..... **DSME**
Country: ..... **Republic of Korea**
Model test establishment used: ..... **Korea Research Institute of Ships and Ocean Engineering (KRISO)**
Flag: ..... **Marshall Islands**
IMO number: **9851830**
Total number of sister ships already completed (excluding ship presented): **4**
Total number of sister ships still on order: **5**

Hunter Tankers took delivery of *Hunter Atla*, the first of seven identical 300,300dwt ECO design VLCC newbuilds, from Daewoo Shipbuilding & Marine Engineering in South Korea in September. Two sisters, *Hunter Saga* and *Hunter Laga*, followed at monthly intervals and the remaining four ships are due for delivery in 2020. The yard also has a separate order for a pair of the vessels from Oman Shipping company.

Justifying their ECO design label, *Hunter Atla* has been equipped with a comprehensive range of environmental protection systems. There is a Wärtsilä scrubber treating exhaust from the main, auxiliary engines and boilers for compliance with 2020 SOx rules, and an SCR system for main engine and generator engines to meet NOx Code Tier III levels.

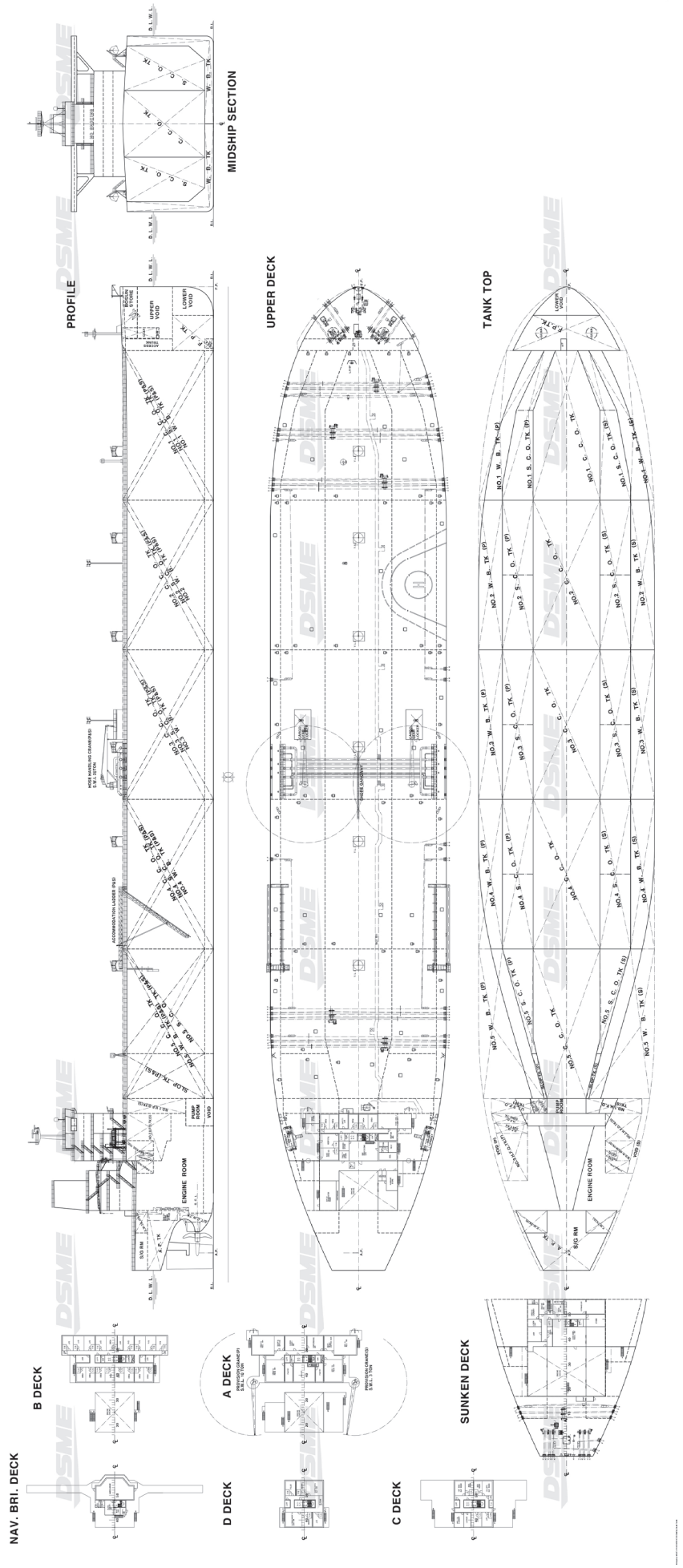
The hull dimensions are a loa of 336m, a beam of 60m and a depth of 29.5m. The hull form features DSME's streamlined DS Bow and various energy saving devices such as DSME duct, long cap and rudder bulb, all helping to reduce fuel consumption. The main engine is a derated MAN B&W 7G80ME-C9.5 model producing 24,510kW at 66.4rpm at MCR and 17,160kW at 70% MCR running at 59rpm. A 10.6m fixed pitch propeller directly coupled allows for a 12knots service speed, or a 14.8knots maximum speed consuming 59tonnes HFO daily.

DSME's Crosstie-less design has been applied to cargo tanks for preventing potential fatigue cracking of crosstie and permitting easy tank cleaning due to the simpler structure. As is typical for a VLCC, there are five tanks split into port starboard and centre for a total of 15 cargo tanks and two slop tanks. Three Shinko cargo pumps each with a capacity of 5,500m^3/h are installed.All seven vessels will be operated in the Tankers International Scrubber Pool and will trade in the spot market.

TECHNICAL PARTICULARS

Length oa: 336.0m
Length bp: 330.0m
Breadth moulded: 60.m
Depth moulded
to main deck: 29.5m
to upper deck: 29.m
Width of double skin
side: 3.m
bottom: 3.0m
Draught
scantling: 21.6m
design: 20.5m
Gross: 156,452gt
Deadweight
Design: 280,760t
scantling: 300,300t
Block co-efficient (at Scantling draft): .... Approx. 0.78
Speed, service (70%MCR output): 14.8knots
Cargo capacity (m^3)
Liquid volume: 341,870
Bunkers (m^3)
Heavy oil: 6,435
Diesel oil: 650
Water ballast (m^3): 94,032
Tankers - percentage segregated ballast: .Approx. 100% (ballast tank only)
Daily fuel consumption (tonnes/day)
Main engine only: 62.9
Classification society and notations:..... Lloyd's Register (LR) +100A1, Double Hull Oil Tanker, CSR, ESP, ShipRight (ACS(B, C), CM, FDA Plus(40,WW)), *IWS, LI, DSPM4, +LMC, IGS, EGCS(OPEN), UMS, NAV1, with the descriptive notes COW(LR), ShipRight (BWMP(T), VECS, SCM, IHM) DNV-GL: +A1, Tanker for oil, CSR, ESP, COAT-PSPC(B,C), CMON, BIS, LCS, SPM, E0, NAUT(NAV), BWM(T), VCS(2), TMON, Recyclable, CLEAN, ER(EGCS OPEN), descriptive note on "Target fatigue life of 40 years in worldwide operation basis"
% high-tensile steel used in construction: 61.5%
% aluminium used in hull/superstructure: 0%
Main engine(s)
Design: ..... MAN Energy Solutions
Model: ...MAN B&W 7G80ME-C9.5 (derated)
Manufacturer: ..... HHI
Number: 1
Type of fuel: .....HFO, ULSFO and LSMGO
Output of each engine: 24,510kW at 66.4rpm at MCR, 17,160kW at 59.0rpm at NCR (70% MCR)
Propeller(s)
Material: ..... Ni-Al-Bronze
Designer/Manufacturer: ..... Nakashima
Number: 1
Fixed/Controllable pitch: .....Fixed
Diameter: 10.6m
Speed: .....66.4rpm at MCR, 59rpm at NCR
Special adaptations: .....Propeller ESCAP (manufacturer: MMG)
Diesel-driven alternators
Number: 3
Engine make/type: ..... STX-MAN/4-stroke, trunk piston, in-line
Type of fuel: .....HFO, ULSFO and LSMGO
Output/speed of each set: ..... 1,540kW at 900rpm
Alternator make/type: .....Hyundai electric / HFJ7 634-08P
Output/speed of each set: 1,460kW / 900rpm
Exhaust-gas scrubbing equipment
Manufacturer: ..... Wärtsilä
Type: ..... Open, venturi, SW scrubbing
On main engines?: ..One(1) set for ME, GEs, aux. boilers and donkey boiler
Auxiliary Boilers
Number: 2
Type/Make: .....Vertical/Kangrim
Output, each boiler: .....45,000kg/h, 20bar g. saturated (working pressure)
Donkey Boilers
Number: 1
Type/Make: .....Vertical/Kangrim
Output, each boiler: .....3,000kg/h, 6bar g. saturated (working pressure)
Cargo cranes/cargo gear
Number: .....2 sets
Make: .....Oriental
Type: .... Electro-hydraulic, single jib, cylinder luffing
Performance: .....20t (SWL)
Other cranes
Number: .....2 sets
Make: .....Oriental
Type: .... Electro-hydraulic, single jib, cylinder luffing
Tasks: .....For handling provisions and engine spare parts
Performance: .....10 & 3t (SWL)
Mooring equipment
Number: .....11 sets
Make/ Type: .....Mirae Industries/Hydraulic
Cargo tanks
Number: .....5 pairs of side cargo tanks, 5 center cargo tanks, 2 slop tanks
Grades of cargo carried: .....Crude oil
Cargo pumps
Number: 3
Type: ..... Centrifugal, vertical, single stage
Make: ..... Shinko
Stainless steel: .....Impeller shaft
Capacity (each): .....5,500m^3/h x 150mTH
Cargo control system
Make: .....Emerson
Type: ..... Conventional control console type
Water ballast Treatment System
Make: .....Techcross
Capacity: .....3,000m^3/h x 2 units
Complement
Officers:..... 15
Crew:..... 15
Suez/Repair Crew: 6
Single/double/other rooms: .....31 cabins
Stern appendages/special rudders: ..... DSME duct, long cap and rudder bulb
Bridge control system
Make: .....Kongsberg
Type: .....Bridge manoeuvring system (Autochief 600)
Is bridge fitted for one-man operation? ..... Yes
Fire detection system
Make: .....Consilium
Type: .....Addressable type
Engine room: .....
Make/Type: .....NK/ high-expansion foam
Radars
Number: .....S-band, X-band radar (2 sets)
Make: .....Furuno
Model(s) ..... S-band: FAR-2338S-NXT-BB, X-band: FAR-2228-BB
Integrated bridge system?: .....No
Waste compactor
Make/Model:.....Uson/UBP-30S
Sewage plant
Make/Model:.....IL Seung/ISB-02
Efficiency
Attained EEDI value: 2.18
Required EEDI value: 2.33
Other installed monitoring tools: .....Cargo/ballast monitoring system, remote level & draft gauging system, shaft horsepower meter
Energy Saving Technologies: .....DSME Duct, Long cap, Rudder bulb

Contract date: .....2 February 2018
Launch/float-out date: ..... 1 June 2019
Delivery date: .....24 September 2019


MIDSHIP SECTION
PROFILE
UPPER DECK
TANK TOP
NAV. BRI. DECK
B DECK
A DECK
D DECK
C DECK
SUNKEN DECK
ENGINE ROOM
PUMP ROOM
S/G RM
D.L.W.L.
UPPER VOID
LOWER VOID
ACCOMMODATION LADDER (P&S)
SHORE GANGWAY

NISSOS RHENIA: Very large crude carrier

Shipbuilder: ..... **Hyundai Heavy Industries**
Vessel's name: ..... ***Nissos Rhenia***
Hull No: **3012**
Owner/Operator: ..... **Kyklades**
Country: ..... **Greece**
Designer: ..... **Hyundai Heavy Industries**
Country: ..... **Republic of Korea**
Model test establishment used: ..... **Hyundai Maritime Research Institute (HMRI)**
Flag: ..... **Marshall Island**
IMO number: **9845685**
Total number of sister ships already completed (excluding ship presented): **7**
Total number of sister ships still on order: ..... **nil**

First in a series of what was initially four ships, *Nissos Rhenia* is a 319,000dwt VLCC constructed by Hyundai Heavy Industries in Ulsan and managed by Kyklades Maritime Corporation. The series was later extended to eight ships and a further three vessels of the same type have been constructed for a different owner. Of the eight vessels operated by Kyklades, seven were delivered in 2019 and the last in January 2020. The ship is owned by Okeanis Eco Tankers (OET).

The vessel's dimensions are a loa of 333m, a beam of 60m and a draught of 22.6m. *Nissos Rhenia* has 15 cargo tanks – five centre tanks and five pairs of side tanks – and two slop tanks. There are three cargo pumps each capable of 5,000m^3/h and the ship is fitted with two 3,000m^3/h Sunrui ballast water treatment systems.

Nissos Rhenia and its sisters are all fitted with seven cylinder Hyundai-built WinGD X82-B engines with a power rating of 33,250kW at 84rpm, although it will normally be run at 66rpm with a 24,500kW output. The engine drives a 10.4m diameter fixed pitch propeller for a service speed of 11.2knots and a consumption of 83tonnes HFO per day. Its maximum speed is 14knots.

OET's strategy is to operate eco vessels that are scrubber equipped for meeting IMO 2020 rules. *Nissos Rhenia* has been claimed to be the first eco-friendly VLCC with both SCR and a scrubber installed at the newbuilding stage. The SCR system needed to meet IMO Tier III is a high pressure type on the main engine, while the three Himsen auxiliaries have a low pressure system.

The scrubber fitted to the vessel is an Alfa Laval PureSox open loop type with multi inlet to treat exhaust from the main engine, auxiliaries and the boiler.

TECHNICAL PARTICULARS

Length oa: 332.995m
Length bp: 327.0m
Breadth moulded: 60.0m
Depth moulded
to main deck: 30.4m

Width of double skin
side: 3.0m
bottom: 2.9m
Draught
scantling: 22.6m
design: 21.0m

Gross: 160,457gt
Deadweight
design: 290,353t
scantling: 318,953t

Speed, service (-- %MCR output): ..14.4knots at scantling draught (72.2%)

Cargo capacity (m^3)
Liquid volume: ..... abt. 355,800m^3
Bunkers (m^3)
Heavy oil: ..... abt. 4,600m^3
Diesel oil: ..... abt. 800m^3
Water ballast (m^3): ..... abt. 90,900m^3

Daily fuel consumption (tonnes/day)
Main engine only: ... 65.2MT/day (tier II mode without scrubber operation)

Classification society and notations:..... DNV GL, +1A,tankerforoil,ESP,CSR,CMON,BIS,BWM(T), BWM(E(s)),VCS(2B),COAT-PSPC(B,C),LCS,E0,TMON, SPM, BMON, Clean, Recyclable.

Main engine(s)
Design: ..... Hyundai-WínGD
Model: 7X82-B
Manufacturer: .....Hyundai Heavy Industries (engine & machinery division)
Number: 1
Type of fuel : .....HFO, ULSFO or MGO
Output of each engine: ..... 33,250kW x 84

Propeller(s)
Material: ..... Ni-Al-Bronze
Designer/Manufacturer: ..... Hyundai Heavy Industries (engine & machinery division)
Number: 1
Fixed/Controllable pitch: .....Fixed
Diameter: 10.4m

Diesel-driven alternators
Number: 3
Engine make/type: .....Hyundai, HiMSEN 8H21/32
Type of fuel : .....HFO, ULSFO or MGO
Output/speed of each set: ..1,760kW x 900rpm
Alternator make/type: .....Hyundai, HiMSEN 8H21/32
Output/speed of each set: ... 1,670kW x 900rpm

Exhaust-gas scrubbing equipment
Manufacturer: .....Alfa Laval
Type: ..... Multi-inlet, S.W. wet cleaning, open loop type, Utype
On main engines?: ..... Applied
On auxiliary engines?: ..... Applied
Boilers
Number: 2
Type: ..Automatic, forced draught, heavy fuel oil burning, marine boiler
Output, each boiler: 4,000kg/h

Cargo cranes/cargo gear : Hose handling crane
Number: 2
Type: .....Electro-hydraulic type
Performance: .....20t SWL
Other cranes
Number: 2
Type: .....Electro-hydraulic type
Tasks: .....Provision Handling Crane
Performance: .....SWL 10t (Port)/ 3t (Stbd)

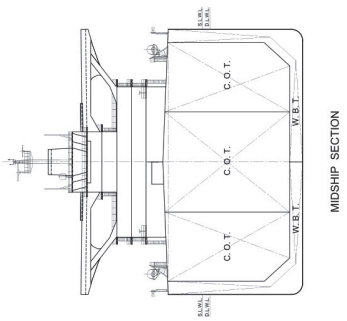
Mooring equipment
Number: ..... 2 windlass, 11 mooring winch
Type: .....Electro-hydraulic type
Special lifesaving equipment
Number of each and capacity: .....2 lifeboat, 40 person each
Cargo tanks
Number: ...5 center cargo oil tanks, 5 pairs of side cargo oil tanks, one(1) pair of slop tanks
Grades of cargo carried: .....Crude oil having flash points at or below 60°C
Cargo pumps
Number: 3
Type: .....Vertical, centrifugal, single stage
Capacity (each): ..... 5,000m^3/h
Cargo control system
Type: .....Control console of piano type

Ballast control system
Type: .....Control console of piano type
Water ballast Treatment System
Make: .....Sunrui
Capacity: ..... 2x 3,000m^3/h

Complement
Officers: 19
Crew: 12
Suez/Repair Crew: 6
Bridge control system
Make: ..... Nabtesco
Type: M-800-V
Is bridge fitted for one-man operation? .....No

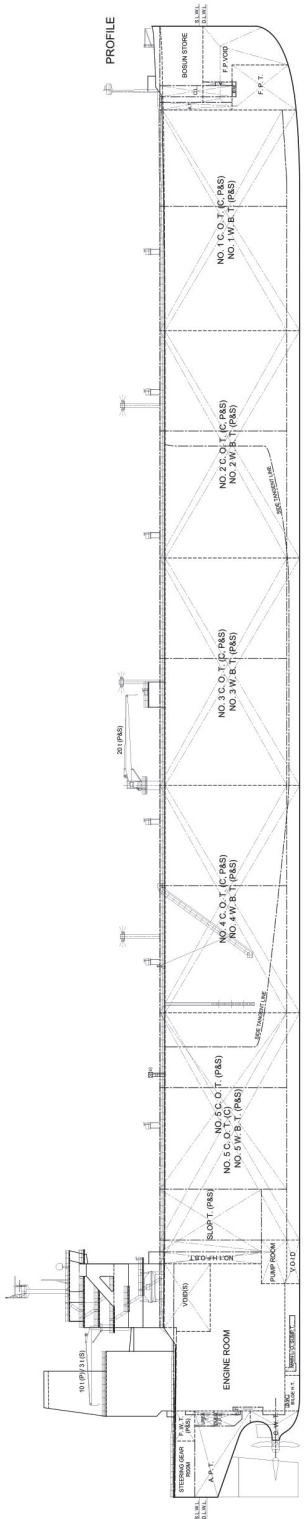
Fire detection system
Make: .....Consilium
Type: .....Salwico
Fire extinguishing systems
Cargo holds:
Make/Type: .....Foam, Sea water
Engine room:
Make/Type: .....CO_2, Sea water
Cabins:
Make/Type: ..... Sea water
Public spaces:
Make/Type: ..... Sea water
Radars
Number: ..... 2 sets (X-band radar x 1set, S-band radar x 1set)
Make: .....Furuno
Model(s) : FAR-3320, FAR3330S-SSD
Integrated bridge system: ..... Yes
If yes, make: .....Furuno
Model: FMD-3300
Waste disposal plant
Waste handled: ...Incinerator & sewage plant

Contract date: .....8 December 2017
Launch/float-out date: .....28 February 2019
Delivery date: .....4 May 2019



MIDSHIP SECTION

PROFILE



UPPER DECK